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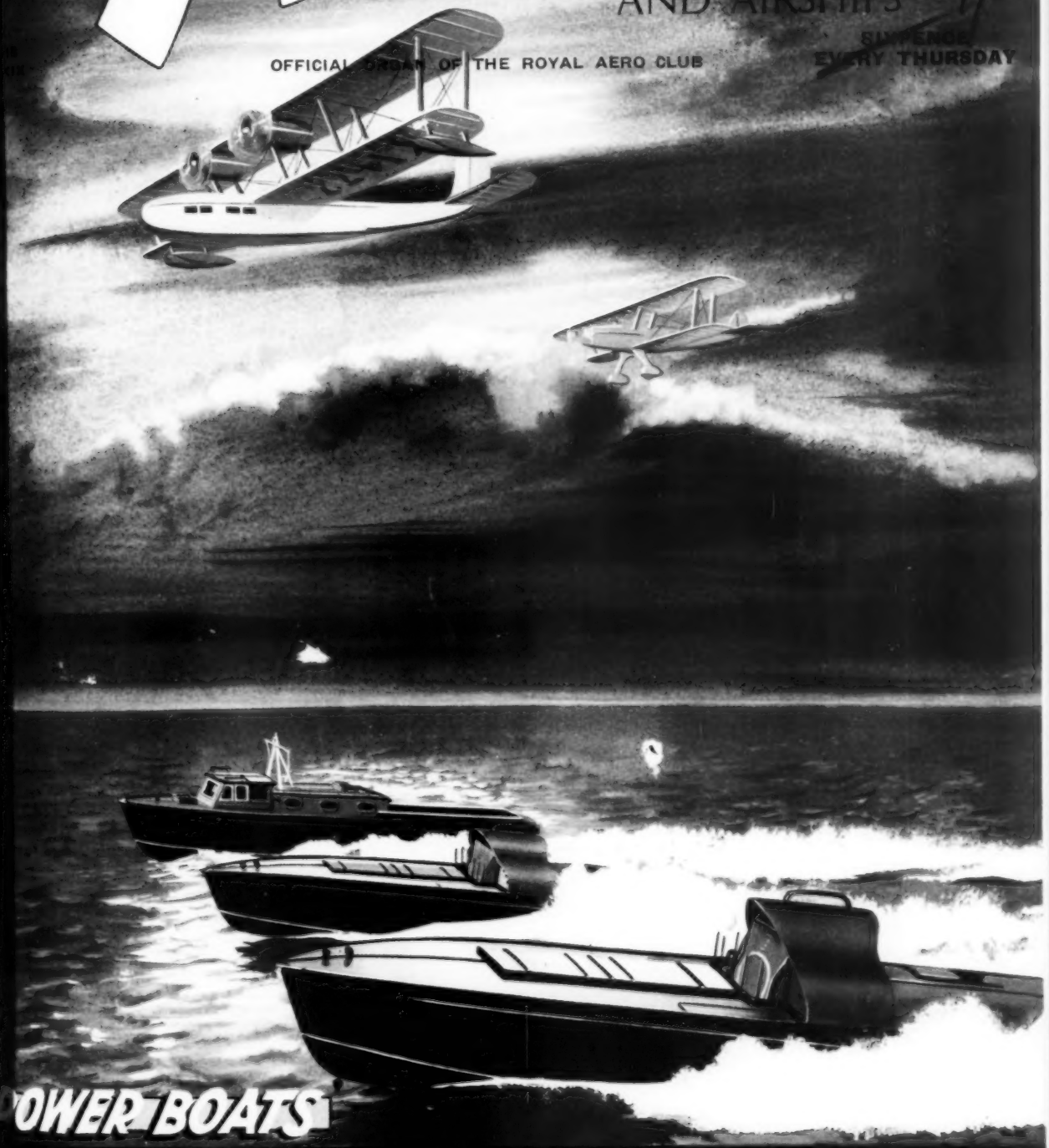

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

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Why?

THE first attempt to hold air exercises in the winter has ended in tragedy. Two heavy bombers came to grief, and in each case three of the crew lost their lives. Naturally, some members of the public have raised the question of why such a risk was run—why were the machines sent up in bad weather? The answer is that no fighting Service can afford to be a mere fair-weather Service, and that if there ever is another war the Royal Air Force will have to fly through bad weather. If the pilots had never practised winter operations in peace time the probability would be that in the "real thing" they would suffer an unnecessary number of casualties from weather as apart from enemy action. The lesser risk must be faced in order to avoid the greater.

The crash at Beacon Hill, near Elsted, on the South Downs, in which a Heyford of No. 10 (Bomber) Squadron was destroyed, seems, from the accounts hitherto published, to be explainable. The crew are said to have just asked Tangmere for their position, and they were probably making for that aerodrome, which was only a few miles away. It is quite conceivable that the machine came out of a cloud bank on top of the Downs and hit the hill, which is a high one, before the pilot could take steps to avoid it.

It is much less easy to account for the loss of the other machine, belonging to No. 97 (Bomber) Squadron, which ran out of petrol and came down in the sea just off the French coast at Havre. The pilot, F/O. R. H. Page, was saved, and will in due course give his own account of what happened. He is an experienced officer, who was promoted to his present rank in January, 1933, and before No. 97 (B) Squadron was formed on September 16 last year he was in No. 10 (B) Squadron, which is also stationed at Boscombe Down and which is equipped with Heyfords. Until an explanation is forthcoming, it is difficult to understand how, with all the modern devices of wireless and instrument flying at its command, a machine can get so badly lost that it should run out of petrol when on the far side of the Channel. It seems that the pilot showed resource and ability in putting his machine down successfully in shallow water, and that there was every reason to expect that all the crew would be saved. The local French papers are reported to have expressed great indignation that only one of them was rescued. The mystery, however, is not what happened after the landing, but why the machine should have had to land on the other side of the Channel.

These losses were followed by another tragedy which is also a mystery. A machine flown by the chief instructor at Cranwell crashed, the instructor and his passenger being killed. So far as anything human is certain, one would have said that an ordinary flight by a chief flying instructor of any R.A.F. flying school was certain not to end in a fatal crash. No explanation can be suggested, and *Flight* can only offer the deepest sympathy to the relatives of all the victims of these tragedies.

Citizen Airmen

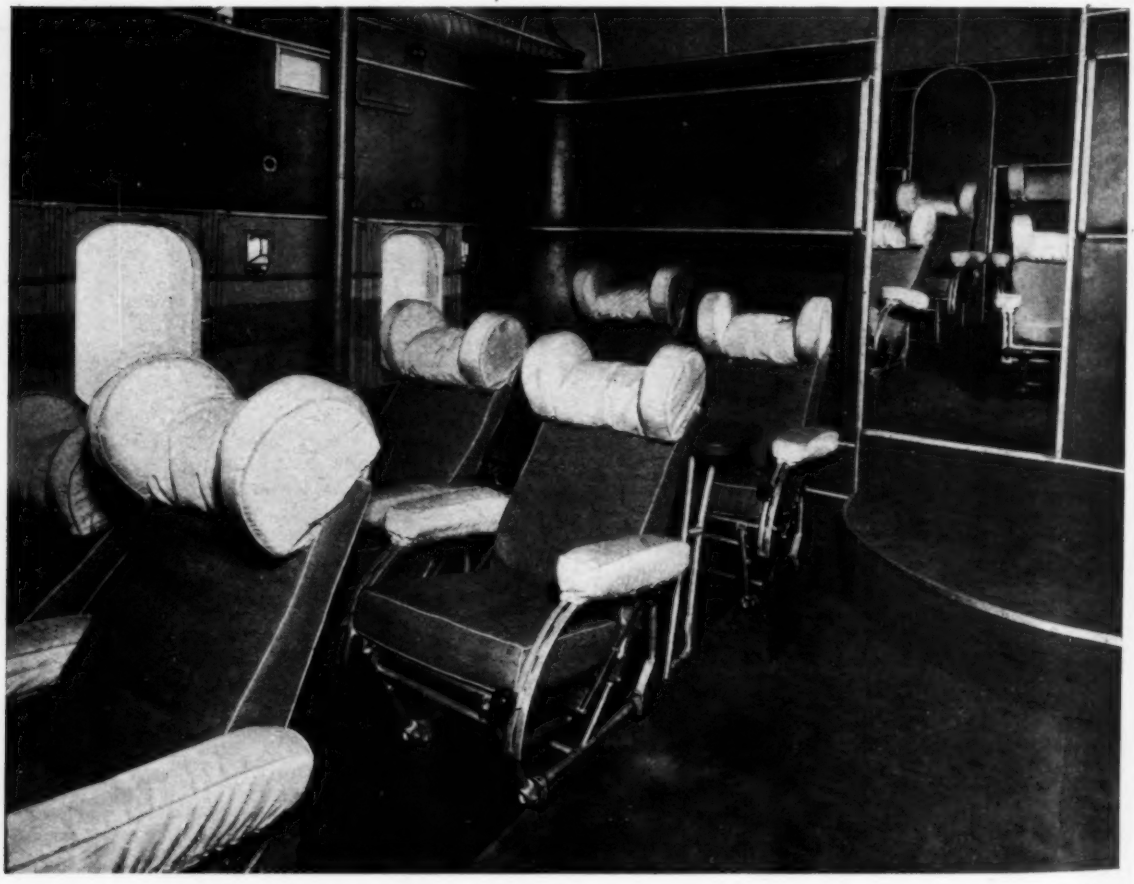
SHOULD the Special Reserve Air Force and the Cadre squadrons, as such, be abolished, and those squadrons converted into units of the Auxiliary Air Force? This interesting matter is now under discussion.

Some confusion is naturally created in the public mind by the number of classes into which our air defenders are divided. There are the Royal Air Force, the R.A.F. Reserve, the Special Reserve, and the Auxiliary Air Force. The difference between these classes has often been explained in *Flight*, and it is very fully set forth in the *Flight* book, *Squadrons of the Royal Air Force*. In brief, an Auxiliary A.F. squadron is composed almost mainly of citizen airmen, while in a Cadre squadron there is one flight of regulars, while the rest of the strength is made up of Special Reserve officers and men. There are five Cadre squadrons, two equipped with light bombers and three with heavy bombers.

In general, it may be said that heavy bombers, which have to do a great deal of night flying, ought to be manned by regulars, for on Monday mornings the Special Reservists have to attend to their civilian duties, which may suffer if the men have been flying all the night before. But it is certainly a moot point whether the Cadre squadron or the A.A.F. squadron gives the best results. In the former regulars and non-regulars are brought into close touch. The regulars are permanent inhabitants of the messes and quarters, and they naturally lend an air of official status to the squadron. The Special Reservists tend to take their tone from the regulars. The result of this commingling of two sets of men produces a very happy result. From the point of view of operational efficiency, one would naturally expect a higher standard from a Cadre squadron than from a unit of the A.A.F.; but the latter are so very efficient that comparisons become odious. At any rate, in an emergency it would be possible to get at least one flight of a Cadre squadron into action without any delay, such as might occur through waiting for the non-regulars to mobilise, and that would seem an advantage.

The Auxiliary squadrons are almost wholly non-regular, and so each of them finds efficiency in its own way, with a minimum of lead from the Royal Air Force. In an emergency there is no reason to suppose that they would be any slower in getting into action than the Territorial sappers and gunners who man the anti-aircraft ground defences; and so, if the voluntary principle is held good enough in the case of the latter, there is no valid reason why it should be frowned upon in the case of the former.

An Auxiliary squadron must cost the country less than a Cadre squadron costs, and a Cadre squadron must be cheaper than a regular squadron. If economy is to be the ruling principle, it would certainly be a good thing to convert the Cadre squadrons into A.A.F. squadrons. But in these days of expansion, economy by itself cannot be allowed to outweigh considerations of defence efficiency. The raising of new regular squadrons would certainly be simplified and expedited if the regular officers and airmen now posted to the five Cadre squadrons were set free to form the nuclei of new regular squadrons. Whether it would be a simple matter to replace them at once by citizen airmen when the squadrons were handed over to the A.A.F. is a matter for consideration. In some counties plenty of suitable recruits could easily be found, but in other localities this is more doubtful. A good deal depends on the prosperity of each county, and recruiting by the regular R.A.F. is now very keen.



IMPERIAL LUXURY: The after cabin of one of the new Short "Empire" flying boats, seen from the promenade cabin. For night work, bunks will be rigged above the luxurious seats—which, it will be noted, are provided with adjusting levers to set the backs to any desired angle. By day the boat will carry 24 passengers, and 16 by night—which suggests even more intricate booking problems for the Imperial Airways traffic staff. This photograph, of course, is not of the interior of an actual boat, but of the careful "mock-up" which serves as a guide to the fitting-out of the finished article. (Imperial Airways photograph.)

The Outlook

A Running Commentary on Air Topics

Germany and the "I.L.I.S."

THERE will be no combined British exhibit at the International Aero Show ("I.L.I.S.") to be held in Stockholm from May 15 to June 1. In view of the reports of a very large and impressive German participation, this fact is much to be regretted. Incidentally, a somewhat curious position seems to have arisen in that the Swedish exhibition authorities have, apparently, arranged to keep under their own auspices a separate show which is being supplied by Germany in a hall nearly twice the size of the actual exhibition building. To use a homely simile, it is rather like Olympia sponsoring Mr. Ford's exhibition at the White City or in the Albert Hall during the Motor Exhibition.

The existing hangar in Lindarängen is not a large one, and, as it is understood that some ten or twelve British firms will arrange individual exhibits, Great Britain will not be unrepresented. But rumour has it that the big German combined exhibit will cover something in the neighbourhood of 2,000 square metres. Obviously, no individual effort can compete effectively, in general mass effect, with such a huge *national* display, whatever may be the relative merits of individual aircraft and engine types.

Flight is well aware of the disinclination of many firms in the British aircraft industry to incur the expense of a British aero show in London, although no such show has been held since 1929, but the total cost of a combined S.B.A.C. exhibit at Stockholm should not have proved prohibitive, and would undoubtedly have done much to maintain British prestige. As it is, one fears that the swastika will be so much in evidence that the 1936 "I.L.I.S." will go down in history as a German aero show.

Things to Come

THAT the Wells film *Things to Come*, at the Leicester Square Theatre, London, is a superb production, outstanding in story and presentation, will be denied by few who see it. From the aeronautical viewpoint, apart from any others, congratulations are due to those responsible.

In an early scene wave upon wave of grim bombers booms in over the white cliffs of England in tight formation and at a low altitude to play havoc with Everytown. Subsequently a Fury (actually Hawker's "1-SE") engages a Mew Gull-ish monoplane and brings it down.

After years of war and pestilence brigandage gains a hold. From the South comes a stranger in a strange flying machine. He is held prisoner by the bandit-in-chief, who typifies the swaggering militarist and who possesses a small number of aeroplanes, including Avro 504s. These he sends up to intercept great twin-hulled Pterodactyls (some very clever "faking" here), flown up from Basrah by progressive-minded young airmen to rescue their comrade and clean-up the world. They drop the "gas of peace," inducing temporary sleep, and gain their ends.

Then science rules, and a great white world arises from the *débris*. The rest of the story is by now well known—how a young couple are fired off from a space gun just as a mob, incensed by an artist who has become maddened by the ever-changing mechanism of a passionless existence, arrives to wreck it.

By the way, there is a highly interesting helicopter, which appears to be a pusher version of the Asboth type, in these final scenes.

Mr. Wells was an early prophet of air power, even before flying had become an accomplished fact. Incidentally, he will be remembered also as a bitter critic of air transport in its rudimentary stage soon after the war. Now that it has become one of the features of the present and the future—though its future is still a mystery—it is natural that Mr. Wells should choose the air and airmen as the instruments of world reform, as he desires to see the world reformed.

To Taper or Not?

THE tendency of a tapered wing to stall first at the tips is again discussed by Dr. Lachmann in *The Aircraft Engineer* pages this week. It will be seen that he does not quite agree with Mr. Andrews, and, in commenting on the Editor's earlier remarks on the docility of some tapered-wing machines and the unpleasant habits of others, Dr. Lachmann writes:—

"I think we know definitely why the bad ones are bad and that preventing the tips from stalling is a safe cure for any tendency to drop a wing. However, we do not know yet with sufficient accuracy why the good ones are good. It is not impossible that preventing the tips from stalling is not the only way of obtaining docility at the stall; it may be that other characteristics, for example, the rate of spreading of burbling across the wing, have a very decisive influence. A very interesting article by Richard H. Smith on "The Stalling of Tapered Wings" in No. 3 of the *Journal of the Aeronautical Sciences*, bears out the same conclusions which are expressed in my first article in regard to the effect of the strong reduction in the downwash angle over the wingtip region which the American author considers as the most pronounced cause of tip burbling. He also deals with the structure of the boundary layer and its effect on the creation of burbling, its spreading towards the centre of the wing and with stability of flow separation as affected by Reynolds number.

Field for Research

"THERE is still quite a wide field for experimental and full-scale research (continues Dr. Lachmann). In regard to full scale research, I suggest that it is most essential that a unique standard is applied when testing the flying characteristics of stalled aircraft.

"Pilots' opinions in regard to stalling characteristics on a certain aircraft vary very widely according to the experience and individual point of view. A pilot who is used to flying slotted aircraft, for example, will be always inclined to apply a much more rigorous standard than a pilot who is less experienced in this direction.

"I therefore suggest that in order to find out the inherent characteristics at the stall, all machines should be subjected to the same trials which are obligatory for slotted Service aircraft.

"Care should also be taken to find out whether apparent stability is only the result of inefficiency of the elevator. There is no doubt in my mind that aircraft with tapered wings which can be made to behave in regard to dropping a wing are much safer from the stalling point of view than aircraft with rectangular wings, because the downwash over the centre portion of a tapered wing, especially over fully tapered wings, does not fail suddenly at the stall—therefore preventing the nose from dropping suddenly and excluding what the French call so fittingly *la panne classique*."

INSIDE the Pl

Details of Vickers-Supermarine Flyi Boat

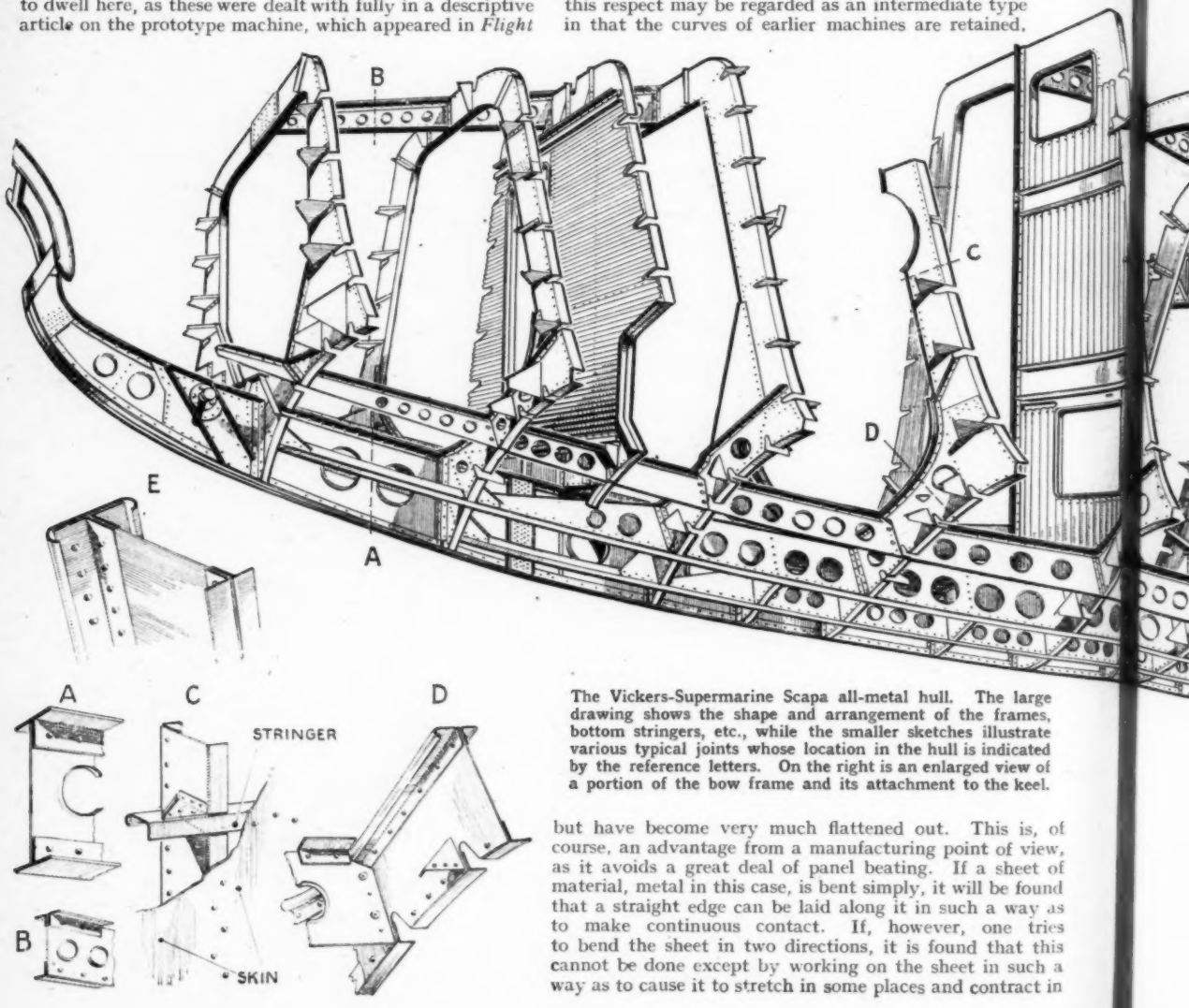
Features o he S

RARELY is it possible to see the inside of a flying boat hull. Particularly is this so when the hull belongs to a military flying boat, of which one usually sees only the outside aspect. It is, therefore, with considerable satisfaction that *Flight* is able to illustrate how a modern British flying boat is built. The subject of our illustrations is the Vickers-Supermarine Scapa, a biplane flying boat which has now been supplied in considerable numbers to the R.A.F. for reconnaissance, bombing and torpedo transport duties.

Of the military features of the Scapa there is little need to dwell here, as these were dealt with fully in a descriptive article on the prototype machine, which appeared in *Flight* of April 26th, 1934. Rather do we propose to confine ourselves in the main to structural features which it has not been permissible to disclose until now.

Fundamentally, the Scapa is a very "clean" biplane flying boat, driven by two Rolls-Royce Kestrel engines mounted in nacelles immediately underneath the upper wing. Light alloys are the materials mostly used in the construction, stainless steel fittings being used for highly stressed parts only.

For some years it was customary for British flying boats to have flaring chines, with the underwater body showing a flat vee curving sharply from keel to chine in order to keep down spray when the machine was taxi-ing and taking off. Modern tendency is towards flat sides and nearly straight-line vees in the hull bottom. The Scapa in this respect may be regarded as an intermediate type in that the curves of earlier machines are retained,

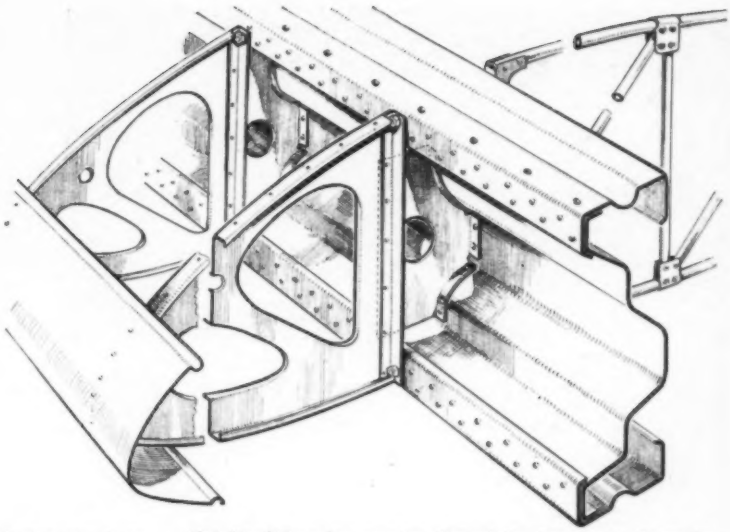


The Vickers-Supermarine Scapa all-metal hull. The large drawing shows the shape and arrangement of the frames, bottom stringers, etc., while the smaller sketches illustrate various typical joints whose location in the hull is indicated by the reference letters. On the right is an enlarged view of a portion of the bow frame and its attachment to the keel.

but have become very much flattened out. This is, of course, an advantage from a manufacturing point of view, as it avoids a great deal of panel beating. If a sheet of material, metal in this case, is bent simply, it will be found that a straight edge can be laid along it in such a way as to make continuous contact. If, however, one tries to bend the sheet in two directions, it is found that this cannot be done except by working on the sheet in such a way as to cause it to stretch in some places and contract in

PLANKING

Boat Construction : Structural the Scapa



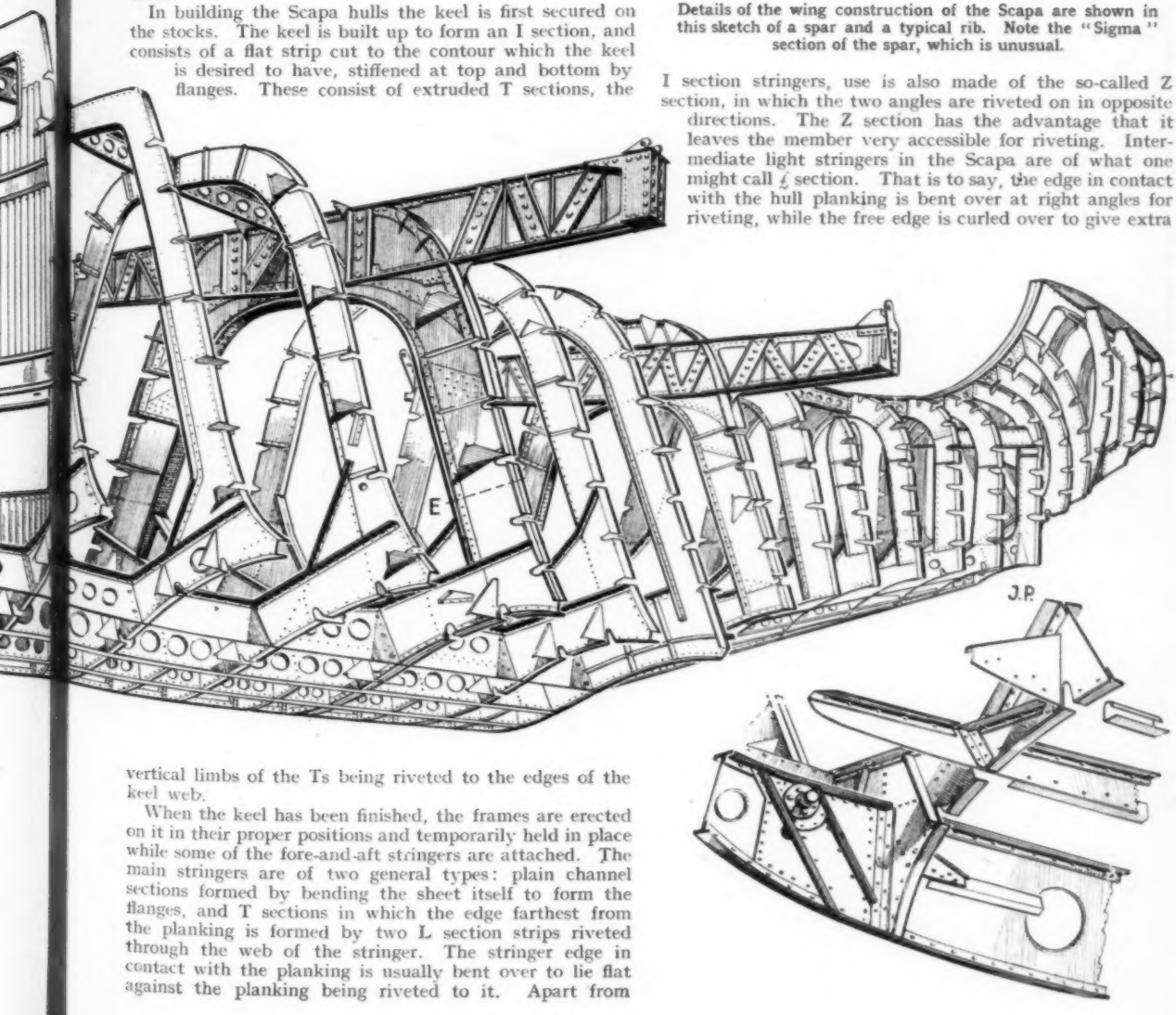
Details of the wing construction of the Scapa are shown in this sketch of a spar and a typical rib. Note the "Sigma" section of the spar, which is unusual.

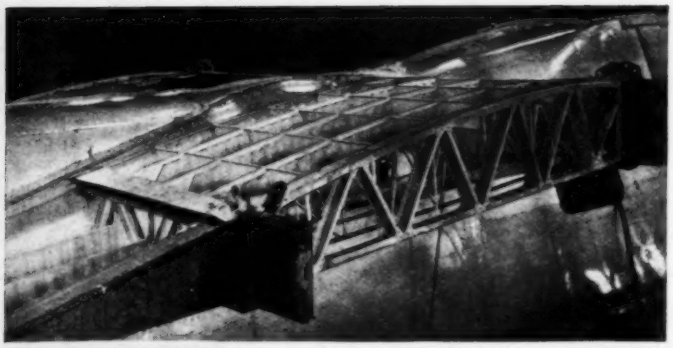
others. It is this process which is known as panel beating. Differently explained, one can bend a sheet of metal around a cylinder but not around a barrel.

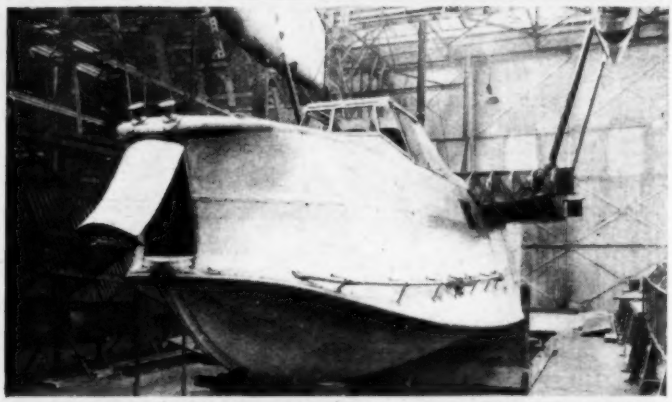
The sections of the Scapa have been so chosen that panel beating is almost entirely avoided, the main exception being the region around the extreme bows. For the rest, the sheet metal covering of the Scapa hull is put on in fairly large panels (roughly 4ft. 6in. long by 20in. wide), so that the number of joints which have to be made watertight is reduced to a minimum.

In building the Scapa hulls the keel is first secured on the stocks. The keel is built up to form an I section, and consists of a flat strip cut to the contour which the keel is desired to have, stiffened at top and bottom by flanges. These consist of extruded T sections, the vertical limbs of the Ts being riveted to the edges of the keel web.

When the keel has been finished, the frames are erected on it in their proper positions and temporarily held in place while some of the fore-and-aft stringers are attached. The main stringers are of two general types: plain channel sections formed by bending the sheet itself to form the flanges, and T sections in which the edge farthest from the planking is formed by two L section strips riveted through the web of the stringer. The stringer edge in contact with the planking is usually bent over to lie flat against the planking being riveted to it. Apart from I section stringers, use is also made of the so-called Z section, in which the two angles are riveted on in opposite directions. The Z section has the advantage that it leaves the member very accessible for riveting. Intermediate light stringers in the Scapa are of what one might call ℄ section. That is to say, the edge in contact with the hull planking is bent over at right angles for riveting, while the free edge is curled over to give extra







The photograph on the left forms an interesting companion to the sketch on the previous page in that it shows the special ribs in the wing root. These ribs are of channel section. Below is a view of the hull, with wing roots in place.

stiffness. The stringers are attached to the frames by small gussets, flanged over to provide the necessary riveting area, as shown in the sketches.

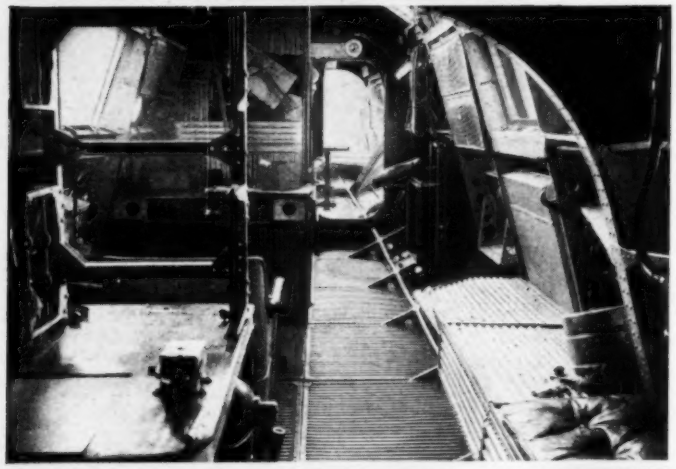
Several types of frame are used. The simplest is a plain channel section, having outer and inner flanges formed by simply bending over the edges of the fresh material itself. Others have the flanges formed by riveted-on angles. The spar frames are of slightly more substantial construction, having two angles riveted on at the planking, two at the free edge, the latter being further reinforced by a capping strip having its edges curled over for stiffness.

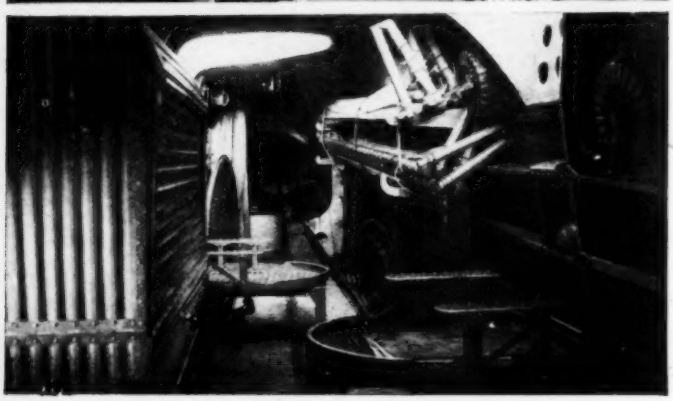
These spar frames have their webs extended upwards to form the webs of the main wing spars, so that the wing roots of the lower plane are actually integral with the hull. The details will be understood from a reference to the drawing on p. 221. It should be noted that the stringers of the Scapa are continuous from bow to stern, and that they are notched into the frames, as shown in the sketches. In another form of hull construction, the frames are continuous, and the stringers interrupted at the frames, being attached to them by gussets. At present it does not seem decided which form of construction is the most satisfactory.

When the frames and most of the stringers are in place on the hull, the planking begins. The chine is formed by an L section strip. This is temporarily held in place by screws to the frames, small pieces of metal of the same thickness as the actual planking being inserted to leave the necessary gap. The sheets of the planking are then "offered up" to the job, marked out, cut to size and fitted. When a perfect fit has been attained, the piece of sheet is taken to the anodising plant for treatment, and when that is finished it is brought back to the job, inserted in its proper place and finally secured by rivets to frames, stringers and chine. Where the plates overlap, the edge of the outer is "stepped" over the edge of the inner before they are riveted together, so that except at the seams the two adjacent plates are perfectly in line. Marine glue is brushed on the edges before the plates are riveted together to ensure watertightness.

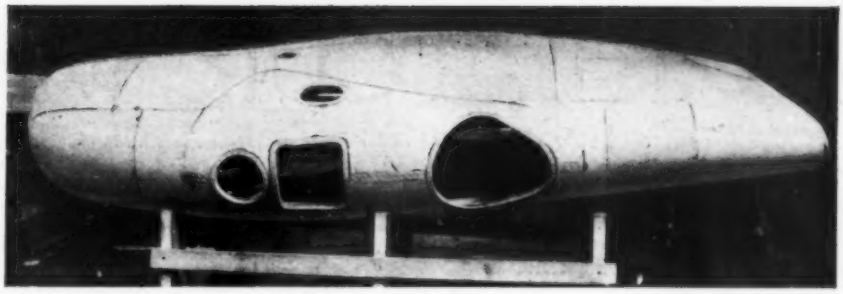
At the two steps a transverse covering strip is used to ensure a watertight joint. This strip is of Z section, and conforms to the transverse shape of the hull at the steps.

In the wing construction of the Scapa fairly normal practice is followed. An exception is, however, found in the wing spars, which are of very unusual section. Perhaps this section may be described as a Σ section resembling roughly the Greek capital letter sigma. It consists of a single corrugated web to which are riveted the two flanges.





Two interiors of the Scapa. In the upper one is looking towards the bows, while in the lower the camera was pointing towards the stern of the hull.



A Scapa engine nacelle. In this view the nacelle has been placed on its side in order to show the inspection doors in the floor by which engineers reach the engines. The nacelle is of all-metal construction.

Several advantages are gained by this very ingenious spar construction. As the spar is "open" from both sides, the riveting, holding-up, etc., becomes very easy. The sections are simple to form on rolling mill and draw-bench, the web by pressing, and finally the attachment of ribs and drag bracing can be very simply carried out.

It is obvious that the type of spar web used is not by itself able to resist any very considerable vertical loads without collapsing. On the side of the spar where the spar flanges are attached to the web, the necessary strength in a vertical direction is obtained by the angle strips used to attach and reinforce the ribs. On the "open" side, similar stiffening is introduced, and where local loads demand stiffeners in between rib locations, these take the form of simple channel section struts, riveted to the spar flange.

The wing ribs are mostly of duralumin tube construction, but some of the heavier ribs, such as those which form compression ribs, or which carry bomb loads, tanks, etc., have channel section flanges with channel section ties.

The gross weight of the Scapa is approximately 7¼ tons, and the wing span is 75ft.; the wing area is 1,300 sq. ft.

Numbers of these machines have now been in service for some time, and the manufacturers state that neither compulsory nor voluntary modifications have had to be made.

BOMBS and BIRDS: A DEPUTATION

VISCOUNT SWINTON, Secretary of State for Air, accompanied by Sir Philip Sassoon, Under-Secretary of State, the Duke of Northumberland, Parliamentary Private Secretary, and senior officials of the Air Ministry and Ministry of Agriculture and Fisheries, last week received representatives of the various national and local bodies interested in the proposal to establish an armament training camp and range on the Northumbrian coast (see leading article in last week's issue of *Flight*).

The Secretary of State reminded the meeting that the Air Ministry had originally chosen a site at Druridge Bay which was eminently suitable for the purpose from the service point of view, but that as a result of a suggestion made by local interests an alternative locality near Holy Island had been investigated. He was extremely anxious to come to a right decision in this matter, and he had therefore called together the interests who were concerned with either area. Whichever of the sites was chosen there would be no bombing practice with live bombs, and training would be confined to machine-gun firing and the dropping of practice bombs which contained no explosive.

The deputation was introduced by Sir Charles Trevelyan, Lord Lieutenant of Northumberland.

The majority of representatives strongly emphasised the national and local objections to a range being established in the neighbourhood of Holy Island in view of its ancient religious and historical associations, and of the fact that the Farne Islands were one of the most notable bird sanctuaries in this country or in Europe. Representations in regard to the Druridge Bay area were primarily concerned with the effect on the local fishing industry, including salmon fishing. It was urged that a number of fishermen would inevitably be displaced.

Viscount Swinton, in replying to the deputation, stated that, having heard all the representations and considered all the relevant facts, he had definitely come to the conclusion that he ought to adhere to the original choice of the Ministry and establish the range at Druridge Bay. The arguments which had been advanced against the Holy Island site were, in his opinion, convincing. Moreover, as he had previously mentioned, the Druridge site had great advantages from an Air Ministry point of view. He would, however, investigate what could be done in the interests of the local fishing industry.

The deputation withdrew after Sir Charles Trevelyan had thanked the Secretary of State.

For Aerodrome Owners Abroad

FEELING that it can be of assistance to aerodrome owners abroad, and particularly in the British Empire, the Aerodrome Owners' Association has decided to open associate membership to owners of aerodromes throughout the Empire and in foreign countries.

The associate membership fee for such owners has been fixed at £2 2s. per annum. Full details are obtainable from the Secretary, Mr. H. R. Gillman, Aerodrome Owners' Association, 32, Savile Row, London, W.1.

Forthcoming Events

Mar. 5. R.Ae.S. Students' Section Lecture: "Airflow Experiments," by W. S. Coleman, 7 p.m. R.Ae.S. Library.
Mar. 6. Leicestershire Aero Club: Dinner and Ball, Grand Hotel, Leicester.
Mar. 10. Royal United Service Institution Lecture: "The Development of Civil Aviation," by Lt. Col. F. C. Shelmerdine, at 3 p.m.
Mar. 19. R.Ae.S. (Coventry Section) Lecture: "Type-Testing and Aircraft" by Flt. Lt. Bulman, 8 p.m., Armstrong Siddeley Canteen.
Mar. 19. R.Ae.S. Students' Section Lecture: "The Monoplane Solution," by R. C. Abel, 7 p.m,, R.Ae.S. Library.
Mar. 20-22. Re-union of Halton Belgium Tour parties, High Leigh, Hoddesdon, Herts.
Mar. 23. R.Ae.S. Lecture: "Welding," by R. H. Dobson Institution of Electrical Engineers, 6.30 p.m.
Mar. 26-29. Yorkshire Gliding Club: Members' Meeting.
Mar. 31. R.Ae.S. Students' Section Lecture: "The Test Pilot's Job," by K. G. Seth-Smith, 7 p.m., R.Ae.S. Library.
April 16. R.Ae.S. (Coventry Section) Lecture: "Aircraft Instruments," by Mr. J. E. Chorlton, 8 p.m. Armstrong Siddeley Canteen.
April 17. Norfolk and Norwich Aero Club: Annual Dinner and Dance.
April 20. "New Light on Strength of Materials Afforded by Modern Physics," by Dr. H. J. Gough. Institution of Electrical Engineers, 6.30 p.m.
April 24. Bristol and Wessex Aeroplane Club: Annual Ball.
April 28. R.Ae.S. Students Section Lecture: "Application of Aerodynamics to Mechanical Engineering," by J. L. B. Jones, 7 p.m., R.Ae.S. Library.
May 15-18. Yorkshire Gliding Club: Open Meeting and Competitions.
May 15-June 1. Stockholm Aero Show.
May 23. Empire Air Day.
May 27-June 4. Austrian Aero Club: Whitsun Tour.
June 6. R.A.F. Flying Club: Annual Display.
June 6-14. Czechoslovakia Aero Club: Tour.
June 20. Brooklands Flying Club: "At Home."
June 27. Royal Air Force Display, Hendon.
July 10 and 11. King's Cup Race.
August 1-2. Yorkshire Gliding Club: Open Meeting.
August 15-30. Yorkshire Gliding Club: Open Meeting and Competitions.
September 5-6. Aero Club of Hungary: Week-end Aerien.
Nov. 13-29. Fifteenth International Aero Exhibition, Paris.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

PROFESSOR PICCARD is trying to raise money for a new ascent into the stratosphere.

Twenty-five members of the London Busmen's Flying Club have qualified for their "A" licences.

A report that Italy's air strength is to be increased by 1,500 new aeroplanes has been denied.

Brigadier-General W. Mitchell, who commanded the American military flying forces in France during the War, died on February 19.

The sum of £15,000 for acquiring and equipping Eastwood Park at Falfield, Gloucestershire, as a civilian anti-gas school has been included in a Home Office supplementary estimate.

Mr. J. V. Fairbairn, Australia's "flying M.P.," will travel to England next month by Imperial Airways. He intends to buy a high-speed British aeroplane, which he will fly home.

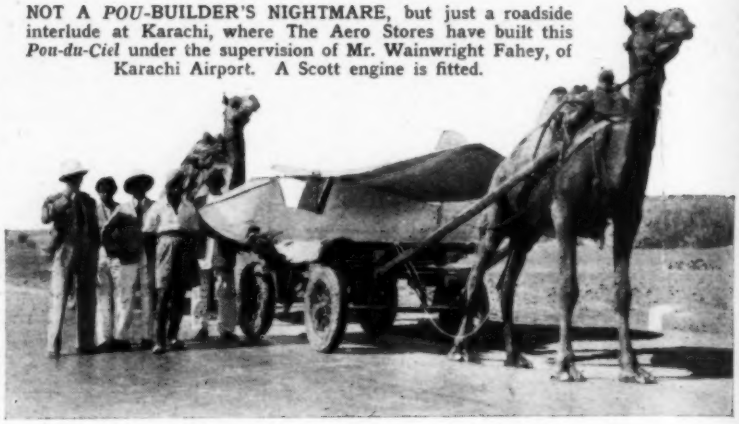
Finnish students have succeeded in raising enough money in a house-to-house collection to build a two-seater bomber. They have decided to make a second appeal for an additional aeroplane.

For flying over a forbidden zone in France, Herr Hans Haux, a German pilot, has been sentenced to sixteen days imprisonment at Seltz, where he landed. His £5,000 aeroplane has been confiscated.

Miss Ione Coppedge and Mrs. Josephine Gerrigus, of Dayton, Ohio, claim to have set up an international woman's altitude record for light aeroplanes. They reached a height of between 14,600 and 15,000ft. in an Aeronca.

The clerk at Stratford police court, when imposing a fine of £2 on Mr. C. W. A. Scott for exceeding the speed limit at Walthamstow, said "This is a gentleman who is used to speeding in an area which is not built up."

NOT A *POU*-BUILDER'S NIGHTMARE, but just a roadside interlude at Karachi, where The Aero Stores have built this *Pou-du-Ciel* under the supervision of Mr. Wainwright Fahey, of Karachi Airport. A Scott engine is fitted.



French Air Force Reorganisation

A plan drawn up by the French Air Minister for the co-ordination of his country's air forces under one chief is expected to be carried out by the middle of March. General Pujo will be made Generalissimo and General Picard will be in command in the event of war.

Pax

The Mablethorpe and Sutton Urban Council has been assured by the Minister of Air that every step will be taken to avoid the holding of bombing practice at the Southern Range during the first three weeks in August, when the holiday season is at its height.

Wind in the Wires

Hearing a droning noise after dark, officials at Kastrup aerodrome, Copenhagen, concluded that a machine had lost itself, and sent up a military two-seater to shepherd it in. They found later—it is reported—that the humming they had heard was the wind in the telegraph wires, and that the machine they had sent had crashed and killed both its occupants.

Cave-man Stuff

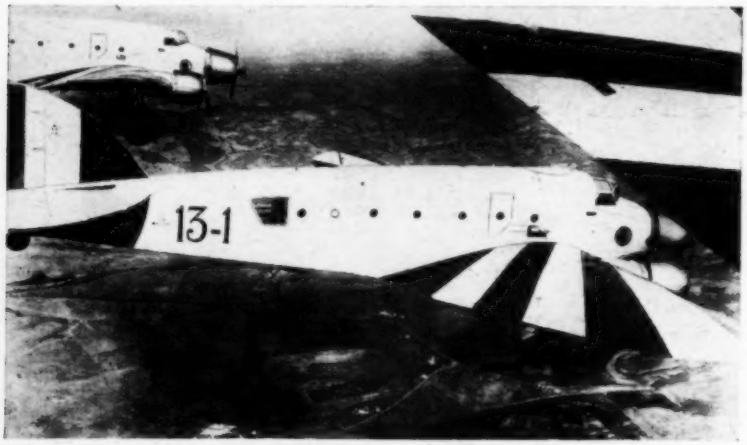
The Scottish Office has received a unique reply to its recent request to local authorities to send representatives to a conference regarding air raid precautions. Portknockie Town Council replied that it did not need to co-operate in this manner as there were sufficient caves in the neighbourhood to accommodate the entire population of the town.

Dorset Service Aerodrome

The Air Ministry, it is understood, is negotiating to secure 250 acres of land near Warmwell, Dorset, for an aerodrome. Two hundred acres of the land is owned by the Earl of Ilchester, who, as chairman of the Southern Sea Fisheries Committee, led the opposition to the Chesil Beach range plans.

A Loss to New Zealand

Flight regrets to record that Sqn.-Leader M. C. McGregor, the oldest competitor in the MacRobertson England-Australia race, in which he did so well, has died from injuries received in an air crash at Wellington airport. Frequently mentioned in *War Birds* (he commanded a flight of No. 85 Squadron), Squadron-Leader McGregor has been closely associated with civil and commercial flying in New Zealand in post-war years.



GAUDY RAIDERS: Italian Savoia Marchetti S.81 bombers of the type which is being used in increasing numbers in Abyssinia. The S.81 may be regarded as a military version of the S.73 used by Sabena.

Twenty-five Years Ago

(From "Flight" of Feb. 25, 1911.)

"Mr. O. C. Morison, starting from Brooklands on Wednesday afternoon with no more fuss than he would make in flying a few miles outside the boundaries of the aerodrome, arrived at Brighton in a time and at a speed that would shame the best express the Brighton and South Coast Railway have running."

Even though it was designed expressly for military duties the Model D resembles in a number of ways the Waco civil types.

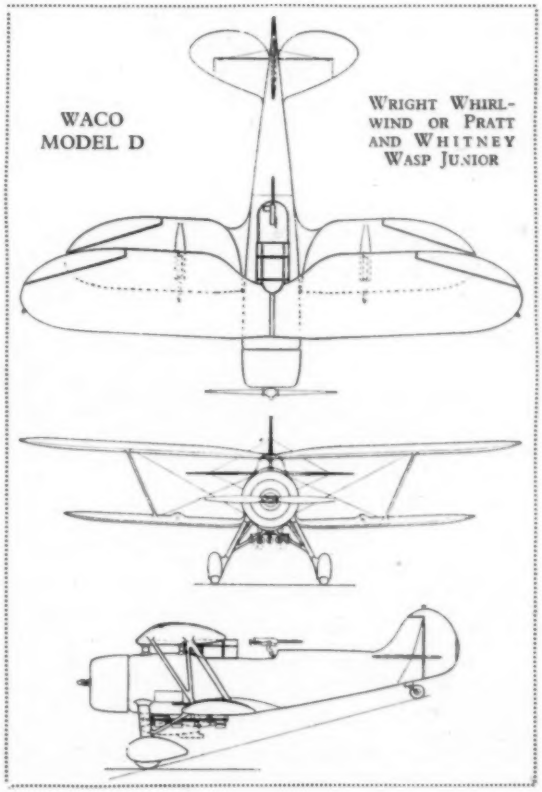
TWO of a KIND

The Waco Model D and the North American NA-16 Light Military General-purpose Types : A High Performing Biplane and Monoplane with Moderate Power

EFFORTS are continually being made by certain American manufacturers to develop versatile and economical aeroplanes for the export market. There are, of course, numerous countries whose requirements do not warrant the acquisition of high-powered and, consequently, expensive machines, and it is these which show interest in such types as the Model D Waco and the North American NA-16. Such machines, incidentally, should make admirable advanced trainers for air services who employ "pukka" high-powered military aircraft.

The Waco Model D

Military Wacos built previous to the Model D were conversions of existing commercial designs, but the new type was constructed expressly to suit military requirements. Essentially a single-bay staggered biplane with wings of unequal span, the Model D is of composite construction. Its wings have spruce spars, spruce and mahogany plywood ribs, compression members of duralumin tubing, leading edges of duralumin and trailing edges of cadmium-plated steel, the whole being fabric-covered. There is no centre section to the top wings, the two panels being joined over the centre line of the fuselage and supported by two tandem vertical struts. Metal-covered ailerons, hinged at an angle to the transverse axis of the aircraft, are fitted to all four planes.



The fuselage is a rectangular structure of chrome-molybdenum steel tubes with rigid bracing, faired to an elliptical cross section which merges gradually into a circular section as it approaches the N.A.C.A.-type cowling.

Undercarriage Features

The split undercarriage is interesting because its wheels maintain a constant angle during the travel of the shock-absorbers; there is no axle in the accepted sense of the word; all attachments are rigid; and the widest tread is available at the moment of contact with the ground.

Pilot and gunner are seated close together in a transparent sliding enclosure which is arranged so that for normal use of the rear gun the gunner is almost completely enclosed.

The Model D is designed to take a wide variety of equipment for fighting, "attack," bombing, observation, mail-carrying, photographic and

ambulance work, and can be supplied with a pair of Edo floats.

As a two-seater fighter, the machine mounts two Browning guns, controlled electrically from the pilot's cockpit and placed in the lower wings. The rear gun, likewise a Browning, is mounted on an arm which swings from side to side of the rear cockpit. Two bomb racks, mounted in tandem under the fuselage, will accommodate five 25 lb. bombs each, or two 125 lb. demolition bombs may be carried in the front rack only.

Either the Wright Whirlwind, or the Pratt and Whitney Wasp Junior radial engine, is normally specified, the powers available ranging from 250 h.p. at ground level to 400 h.p. at 5,000 ft., with a moderately supercharged model. As a fighter the Model D attains speeds of well over 170 m.p.h.

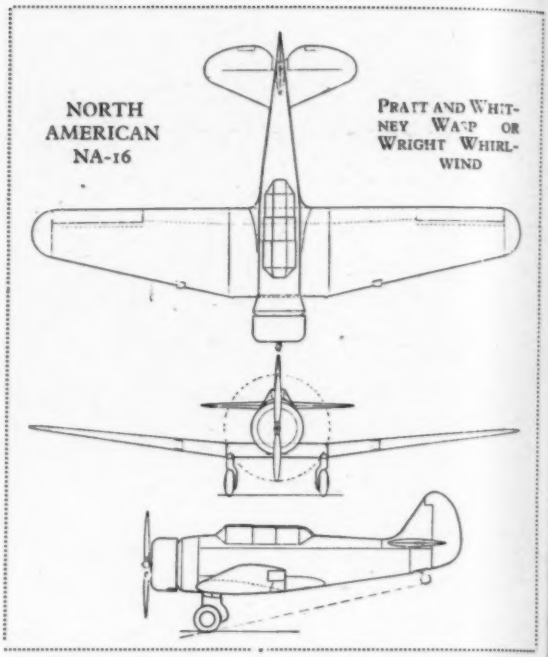
The North American NA-16

A monoplane intended for similar duties to the Waco, the NA-16, is a product of North American Aviation Inc., who have just moved into a new aircraft factory at the Los Angeles Municipal Airport, Inglewood, California. The company is at present working on an order for a hundred basic trainers believed to be similar to the NA-16.

The monoplane wing is a cantilever type of aluminium-alloy stressed-skin construction. Although the centre section is of parallel chord and thickness, the leading edges of the outer panels have a decided sweep-back, which, it is claimed, improves stability and vision from the front cockpit. Split trailing-edge flaps of the Wright type, patented by North American Aviation, are incorporated, being operated mechanically by a very powerful toggle link arranged so that the maximum force required is about 8 lb.

Unlike the wing, the fuselage is a welded chrome-molybdenum steel tubular structure. One particularly interesting feature is the special unit built in between the pilot and observer to protect them in case of an accidental nosing over. The undercarriage is normally an outstandingly simple cantilever type, but a retractable gear may be fitted giving an increase in speed of about 8 m.p.h.

Either one or two synchronised guns may be installed, and the observer has the usual Browning on a track type mounting.



Performance, of course, varies with the type of equipment carried and the engine installed. As a two-seater fighter with a Pratt and Whitney H-type Wasp giving 500 h.p. at 11,000 ft. the maximum speed with fixed undercarriage is 212 m.p.h. at that height. As a single-seater fighter with the same engine this figure is increased by 10 m.p.h.

In this view of the North American NA-16 the fixed undercarriage is fitted : retractable gear may be specified if desired.

For New Motorists

IN December, 1935, the last month for which the figures for Great Britain are available, 22,489 new cars were registered, against 20,991 in December, 1934.

A further comparative increase for the months of January and February is confidently expected when the figures are available. This indicates that a very large number of new motorists are taking to the roads, and with the approach of Easter the rush will certainly be accelerated.

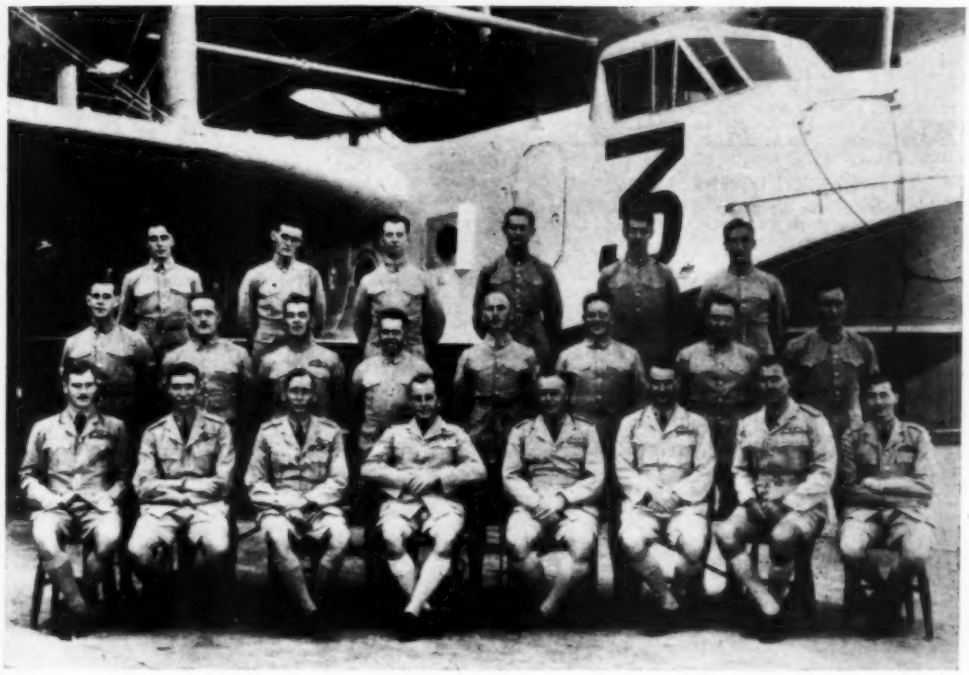
New motorists to-day have to pass examinations which necessitate a quite extensive knowledge of both car and road routine. To help newcomers, to-morrow's issue of *The Autocar* is an enlarged special New Motorists' Number, wherein the very fullest information—legal, mechanical and financial—is set forth clearly to enable every prospective motorist to grasp exactly what his ownership of a car will cost, what he must do to satisfy the law, and how to obtain the best use and extract the utmost enjoyment from his car.

Another Stinson Model

RESEMBLING, in a general way, a scaled-down and twin-engined version of the tri-motor Model A, the Stinson Model B, which is now being built, will have a pair of 260-h.p. Lycomings. The estimated cruising speed conferred by these units is 160 m.p.h. at 6,000 feet. Normally six seats will be provided.

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS



TOWARDS JAPAN: Air Commodore Sydney W. Smith, O.B.E., A.O.C., Far East, with officers and airmen of No. 205 (F.B.) Squadron, which is now on a cruise from Singapore to Japan. The squadron was due to arrive at Kasumagaura on Tuesday last.

A ROYAL PROMOTION

H.R.H. the Duke of York has been promoted from Air Marshal to Air Chief Marshal.

H.M.S. COURAGEOUS

The aircraft carrier *Courageous*, flagship of the Rear-Admiral commanding the aircraft carriers, is to return to England from the Eastern Mediterranean for refit and to give leave to the crew. H.M.S. *Courageous* is normally a unit of the Home Fleet, but has been serving in the Mediterranean for several months on account of the international situation. The personnel has, therefore, not yet been granted Christmas leave.

AIR NAVIGATORS' EXAMINATION

The Air Ministry announces that the following candidates, whose names are arranged in alphabetical order, have passed the examination for the Second Class Civil Air Navigators' Licences held in London during January 1936:—Auping, A., Brecknell, D. F. C., Brunton, M., Burbury, W. H., Coull, R. M., Cripps, S. T. B., Dade, J., Dykes, A. B., Eves, G. P. M., Ghatge, Y. V., Gill, C. S., Hayne, C. R. S., Hoyle, T. W., Johnstone, A. C. P., Long, S. G., May, P. R., McGinn, B. J., McWhannell, P. A., Meares, R. C., Monk, R. C. H., Mouatt, L. R., Murray, E. A. T., Oliver, J. M., Orrell, J. H., Scorgie, D., Shakespeare, J. S., Stead, G. G., Wilson, J. N.

The subjects of the examination were:—International Legislation, Form of the Earth, Maps and Charts, Meteorology, Dead Reckoning and Direction Finding, W/T Navigation, Magnetism and the Compass, Visual Signalling, Morse Flashing, Semaphore and International Procedure.

Sixty-seven candidates sat for the examination. The next examination will be held during the week commencing March 23, 1936.

SUPPLEMENTARY ESTIMATES

Supplementary Estimates of £7,811,100 for the Defence Services were issued on Monday last. The figures for each Service are:—

Royal Navy	£4,850,000
Army	£1,350,000
Royal Air Force	£1,611,000
Ordnance Factories	£100

The greater part of the expenditure has been incurred through special measures in connection with Italy's war with Abyssinia.

PILOTS FROM THE ARMY

A series of amendments to King's Regulations and Air Council Instructions deals with the position of officers reseconded from the Army. A new clause provides that an Army officer, on resecondment to the R.A.F., will take rank and precedence as a flying officer (with honorary rank corresponding to any relatively higher Army rank held). Former service in the R.A.F. in the same or higher rank will count towards seniority.

Officers holding permanent commissions on the active list of the Regular Army who are reseconded to the R.A.F. with temporary commissions therein, and whose substantive Army rate of pay, together with allowances at Army rates, is greater than their R.A.F. rates of pay and allowances, may elect at the commencement of their period of resecondment to receive the pay and allowances of their substantive Army rank until by promotion in the R.A.F. they become eligible for higher emoluments in respect of their R.A.F. rank.

When qualified as pilots, officers seconded or reseconded from the Army will wear the flying badge on the Service dress uniform of their corps or regiments. On return to the Army after the normal period of secondment officers will continue to wear the badge on their Service dress uniform during any period of liability to the R.A.F. on mobilisation.

ROYAL CANADIAN AIR FORCE

Sqn. Ldr. G. S. O'Brian, A.F.C., has relinquished command of No. 10 (City of Toronto) (Army Co-operation) Squadron, R.C.A.F., and has been transferred to the Reserve of Officers. Flt. Lt. W. A. Curtis, D.S.C., of No. 10 Squadron, is promoted to be squadron leader and to command the squadron, to date October 5, 1935.

Flt. Lt. F. G. Wait, on returning to Canada from attending the course at the R.A.F. Staff College, Andover, has been appointed for duty at R.C.A.F. headquarters, Ottawa. Flt. Lt. H. B. Godwin is transferred from the air station at Camp Borden, Ontario, to that at Trenton, Ontario.

OFFICERS AND AIRMEN OF THE JEWISH FAITH

So far as the exigencies of the service permit, leave should be granted to officers and airmen of the Jewish Faith stationed at home who may desire to observe the undermentioned holy days during the current year:—

(i)	Feast of the Passover ...	April 7 to April 14, 1936.
(ii)	Feast of Pentecost	May 27 and 28, 1936.
(iii)	New Year	September 17 and 18, 1936.
(iv)	Day of Atonement	September 26, 1936.
(v)	Feast of Tabernacles ...	October 1 and 2, 1936.

Leave may also be granted to officers and airmen serving abroad at Stations where facilities exist for observing these holy days. The personnel concerned should be excused duty as from sunset on the previous day. The leave granted under this order will count as part of the ordinary annual leave.

FLYING ACCIDENTS

The Air Ministry regrets to announce that Sergt. Edward Kenneth McDermott, L.A/C. Cyril James Adams, and L.A/C. George John Westlake lost their lives in an accident which occurred near Midhurst on February 19, to an aircraft of No. 10 (Bomber) Squadron. Sergt. Charles Albert Deakin, the pilot of the aircraft, was slightly injured.

Also that Sergt. Walter Job, A/C. 1 Cyril Adolphus Tregunnon Bickham, and A/C.2 William Watkin, are missing as the result of an accident which occurred at sea off Le Havre, France, on the morning of February 19, to an aircraft of No. 97 (Bomber) Squadron. The missing airmen were all passengers in the aircraft. The pilot of the aircraft F/O. Robert Humphrey Page, is safe.

Also that Sqn. Ldr. Gilbert Henry Martingell, A.F.C., Royal Air Force, and A/C.1 Robert Tomlinson lost their lives in an accident which occurred at Cranwell on February 20, to an aircraft of the Royal Air Force College, Cranwell. Sqn. Ldr. Martingell was the pilot and A/C.1 Tomlinson the passenger.

FORMATION OF No. 98 (BOMBER) SQUADRON

No. 98 (Bomber) Squadron formed at Abingdon on February 17. The unit is being equipped with the light bomber type of aircraft and has been placed under the command of the A.O.C.-in-C., Air Defence of Great Britain, in the Central Area.

INTER-SERVICES RUGBY

Last year the R.A.F. XV beat the Army, and this year they have beaten the Navy by way of a start to the Inter-Services Rugby Tournament. The victory, though only by one try (3 points) to nil, is the more gratifying because the Navy has won this match for the previous ten years. The result is also very creditable to the Air Force because Flt. Lt. C. E. Beamish was absent, playing for Ireland. The Navy, on the other hand, was handicapped by the absence of Walsham.

The match was played last Saturday at Twickenham, and the ground was slippery and the ball greasy. Consequently there was not very much accurate play by the three-quarters on either side, while the tackling was as determined as it always is in this match. The R.A.F. forwards really won the match by their superiority in the tight scrums and in the loose play. The Air Force attacked nearly all through the first half, but could not break the Navy's defence. It was towards the end of the second half that F/O. G. A. Walker, who had been hitherto marked with the utmost solicitude by the Navy, contrived to break through and beat two men. Having made the opening, he passed to P/O. S. G. Walker, who drew the Navy's full back, and then passed on to P/O. J. M. Thompson, who had backed up well, and the latter scored a fine try. That was the only score in the game.

The teams were:—

R.A.F.—P/O. P. W. Ashton (Hawkinge); P/O. D. H. M. Craven (Cranwell), P/O. S. G. Walker (Cranwell), P/O. J. M. Thompson (North Weald), Flt. Lt. K. B. B. Cross (Sealand); F/O. G. A. Walker (Mildenhall), P/O. J. L. Barker (Catterick); A/C. G. Greaves (Manston), L.A/C. W. V. Reynolds (Henlow), P/O. M. H. R. White (Cranwell), L.A/C. R. R. McPherson (Digby), F/O. T. N. Coslett (Henlow), L.A/C. W. Gascoigne (Brough), Cpl. Sheppard (Grantham), A/C. J. Holland (Hendon).

ROYAL NAVY.—A.-B. C. R. Knapman; Shipwright R. Hurden, Stkr. B. Marsh, A.-B. J. H. Bailey, Sub-Lt. A. T. Darley; Sub-Lt. J. W. Vavascour, Sub-Lt. St. S. V. Welch; E.-R.-A. H. S. Doggett, Lt. R. J. L. Hammond, Lt. (E.) R. S. Hawkins, Sub-Lt. W. R. Harley, Marine C. Webb, Lt. E. A. Hamilton-Hill, Lt. (E.) N. L. Evans, Lt. (E.) I. G. Aylen.

ROYAL AIR FORCE GAZETTE

London Gazette, February 18, 1935

General Duties Branch

The following are granted short service commissions as Acting Pilot Officers on probation with effect from and with seniority of February 3:—G. Beavis, J. T. Bouwens, J. C. Claydon, M. N. Crossley, F. J. L. Donaldson, D. Fortnum, A. Gadd, G. W. C. Gleed, P. H. Hards, A. M. Jardine, P. A. Matthews, T. E. Shrapnell-Smith, A. H. Smythe, H. A. H. Watts.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—G. W. P. Grant (December 27, 1935); G. E. Valentine (January 11); T. J. Macdermot (January 12); N. C. Walker, C. E. Littler, M. B. Edwards, J. W. C. More (January 26); H. W. Mermagen, W. E. Hooper, G. N. Snarey, A.F.C. (January 27); C. H. Smith (January 28).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—J. R. Gillman (December 24, 1935); P. H. Gibbings, A. P. Hollick (January 6); E. E. Vielle, J. H. Lowe, D. W. Williams (January 28).

Lt.-Cdr. S. Borrett, R.N., Flying Officer, R.A.F., is granted the acting rank of Flight Lieutenant (unpaid) with effect from December 2, 1935. Sqn. Ldr. C. E. V. Porter is placed on the half-pay list, Scale B, from January 21 to February 8 inclusive.

Stores Branch

The following Flying Officers are promoted to the rank of Flight Lieutenant (January 10):—M. H. Robinson, A. J. Howell.

Chaplains Branch

The Rev. P. J. Macken is granted a short service commission with the relative rank of Squadron Leader with effect from and with seniority of February 3.

Memorandum

The permission granted to Lt. F. C. Edwardes to retain his rank is withdrawn on his conviction by the civil power (January 22).

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

E. M. Thompson is granted a commission as Flight Lieutenant in Class C (January 1).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commander.—E. J. Cuckney, D.S.C., to Central Flying School, Upavon; for Engineer duties, 10.2.36.

Squadron Leaders.—E. W. Broadberry, M.C., to Air Observers School, North Coates Fitties, for flying duties, 10.2.36. R. M. C. Macfarlane, M.C., to School of Army Co-operation, Old Sarum; for Administrative duties vice Wing Cdr. R. Young, 5.2.36. P. G. Scott, to Marine Aircraft Experimental Establishment, Felixstowe; for Administrative duties vice Wing Cdr. E. C. Emmett, M.C., D.F.C., 10.2.36. C. E. V. Porter, to No. 1 Armament Training Camp, Catfoss; for Armament duties, 10.2.36.

Flight Lieutenants.—N. C. Odbert, to No. 609 (West Riding) (B) Squadron, Yeadon, 10.2.36. J. A. C. Stratton, to No. 610 (Co. of Cheshire) (B) Squadron, Hooton Park, 10.2.36. H. C. Parker, to No. 611 (West Lancashire) (B) Squadron, Speke. J. C. Cunningham, to No. 49 (B) Squadron, Bircham Newton, 10.2.36. A. Hesketh, D.F.C., to No. 2 Armament Training Camp, North Coates Fitties, 14.2.36.

Flying Officers.—H. M. T. Neugebauer, to No. 8 Flying Training School, Montrose, 11.2.36. T. G. Lovell-Gregg, to No. 3 Flying Training School, Grantham, 10.2.36. J. D. Miller, to No. 821 (F.S.R.) Squadron, 7.2.36.

Pilot Officer.—A. E. Saunders, to No. 49 (B) Squadron, Bircham Newton, 10.2.36.

Acting Pilot Officers.—The undermentioned are posted to R.A.F. Depot, Uxbridge, on appointment to short service commissions as Acting Pilot Officers, on probation with effect from 3.2.36:—G. Beavis, J. T. Bouwens, J. C. Claydon, M. N. Crossley, F. J. L. Donaldson, D. Fortnum, A. Gadd, G. W. C. Gleed, P. H. Hards, A. M. Jardine, P. A. Matthews, T. E. Shrapnell-Smith, A. H. Smythe, H. A. H. Watts, and J. B. Wallace.

The undermentioned are posted to R.A.F. Depot, Uxbridge, on appointment to short service commissions as Acting Pilot Officers, on probation with effect from 10.2.36:—A. J. Banham, J. Beavis, W. H. Cliff, P. M. J. Evans, N. G. C. Heath, C. P. V. Hervey, J. G. Kerby, S. H. Kernaghan, E. J. Little, T. N. Partridge, J. W. C. Powell, J. A. Richardson, G. R. Shepley, R. G. Taylor, J. A. Thomson, A. W. T. Traill, and D. E. A. Williams. D. H. C. Hull, to No. 40 (B) Squadron, Abingdon, 10.2.36. P. E. A. Talbot, to No. 101 (B) Squadron, Bicester, 10.2.36.

Accountant Branch

Flight Lieutenant.—J. Charles, to R.A.F. Station, Worthy Down, 10.2.36.

February 27, 1936 Supplement to FLIGHT

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

No. 121 (Volume XII No. 2) 11th Year February 27, 1936

AIRSCREW DEVELOPMENT

Concluding Sections of the Paper Read Recently by Dr. H. C. Watts Before the R.Ae.S.

The First Part of this Paper was Published in "Flight" of February 6, 1936, and contained Figs. 1 and 2 of Dr. Watts' Paper.

IN the earlier sections of his paper on airscrew development Dr. Watts dealt with aerodynamic design and with materials. He also pleaded for the standardisation of airscrew shafts, calling attention to the cone and key shaft standardised in France, the parallel splined shaft standardised in America, and the flanged shaft end standardised in Germany. Of the three, Dr. Watts preferred the German, which, he thought, left the field open both for existing designs and for future development of the variable pitch airscrew. He gave details of the German flanged shaft ends.

Adaptation to Engine and Aircraft

Turning to the adaptation of the airscrew to the engine and aircraft, Dr. Watts' paper read as follows:—

There has recently been published a report on tests on a family of airscrews of various pitches ranging from 0.3 to 2.5 diameters. This report is a revision as well as an extension of report R. and M. 829. I have extracted the torque characteristics of the various airscrews tested, and shown them with superimposed equal efficiency lines in Fig. 3.

In general, the point corresponding to maximum flying speed with full throttle will be somewhat below maximum possible efficiency as shown by point A for a pitch of 1.5D. This point corresponds to the design conditions.

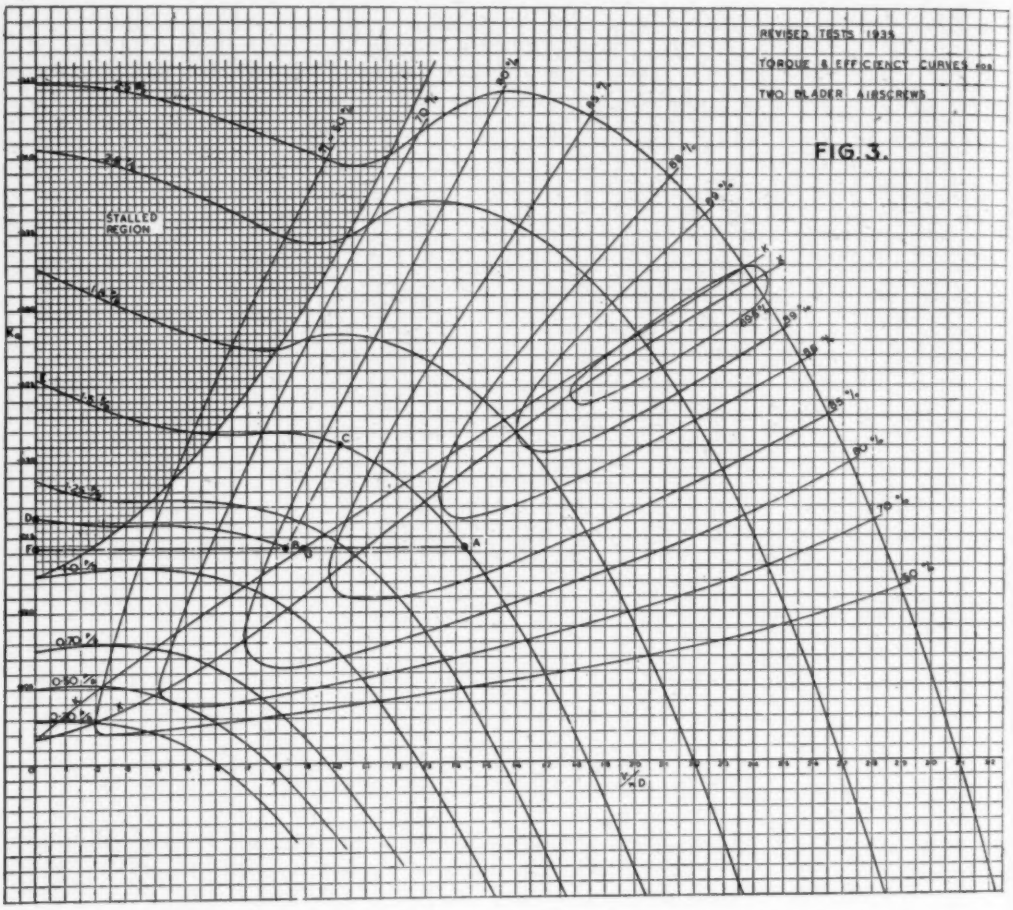
The torque of an internal combustion engine is approximately constant with rate of rotation, and for the purpose of this paper I shall assume it so. The resistance torque of the airscrew, however, varies as the square of the rate of rotation and is expressed as $\rho k_q N^2 D^5$. Where ρ is density of the air, N is the rate of rotation, D the diameter of the airscrew, and k_q is the coefficient shown in Fig. 3 varying with v/nD and pitch diameter ratio.

For a fixed pitch airscrew the torque coefficient increases as the aircraft speed decreases. The rate of rotation must therefore fall so that the airscrew resistance torque $\rho k_q N^2 D^5$ remains equal to the constant engine torque. The rate of rotation is thus a minimum at low aircraft speeds just when unfortunately the maximum power is wanted for take-off.

Fig. 4, derived from Fig. 3, shows for two airscrews having pitches of 0.7 and 1.5 diameters the change in rate of rotation and thrust as the aircraft speed alters. In this figure, as in all subsequent figures, the thrust t, the speed v, and the rate of rotation n are expressed in terms of the designed thrust T, the designed speed V, and the designed rate of rotation N.

It will be noted that although the revolutions fall for the airscrew with $0.7D$ pitch, the thrust steadily rises to a maximum at static conditions. For the airscrew with $1.5D$ pitch the thrust at first rises and then falls away to a value little greater than at top speed. This fall is due to the stalling of the airscrew blades—a phenomenon identical with the stalling of a wing. The figure clearly shows the drawbacks of the fixed pitch airscrew—first a decrease of revolutions with loss of power, and secondly, and much more important, a loss of thrust on the higher pitch airscrew due to the blade stalling. This leads direct to the main theme of this paper: How to develop the airscrew to avoid these losses and to maintain at all speeds the maximum possible thrust.

Look again at Fig. 3. One would like the airscrew to work at maximum possible efficiency at all speeds. To achieve such a result, the torque coefficient curve of such an ideal airscrew must be that represented by line XX, since at any value of v/nD this line corresponds to maximum efficiency. It is cutting across the torque curves of various pitches. Hence the conclusion that the first step towards the achievement of our ideal is some arrangement whereby the pitch of the blade can be changed with changing speed. Further, in addition to aiming at maximum efficiency, one would like also maximum power and hence maximum constant engine revolution at all speeds. This means that the power absorbed by the airscrew, proportional to $\rho k_q N^3 D^5$, must remain constant. The torque coefficient k_q for the ideal airscrew is, however, decreasing with falling speed. Hence the second conclusion that one



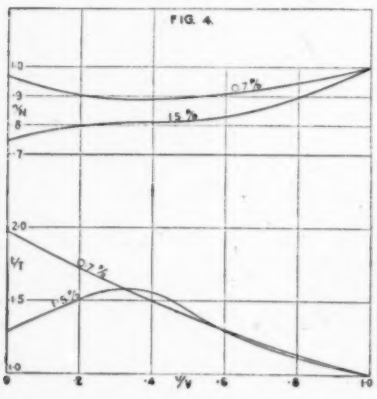
of two things must be arranged for, either the diameter or the airscrew revolutions must be made to increase. If the diameter is kept constant the airscrew revolutions must increase. If the airscrew revolutions are kept constant the diameter must increase. The first alternative means variable pitch plus a variable gear. The second alternative means variable pitch plus variable linear dimensions.

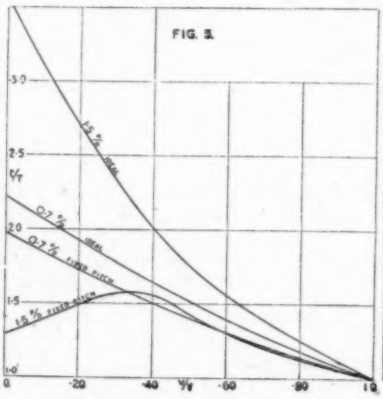
The second alternative I dismiss. It means adding all the complications of variable diameter to those of variable pitch.

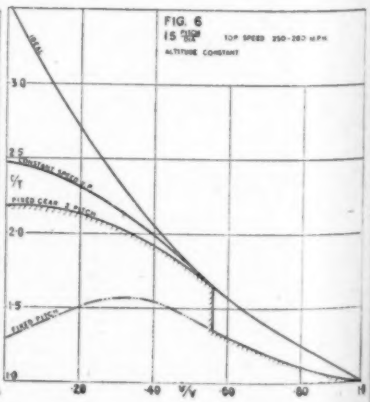
The first alternative is more practical. Carried to the limit it would involve excessively high rates of rotation in the static condition, but out of it arises a number of possible and practical compromises.

Fig. 5 shows the thrust which would be given by such ideal airscrews having primary pitches of $0.7D$ and $1.5D$ diameter respectively. The figure also shows the thrust for the ordinary fixed pitch gear airscrew. The margin between them represents the field for airscrew development.

Particularly note that the ideal airscrew increases the static thrust of the $0.7D$ pitch only 13 per cent. It in-







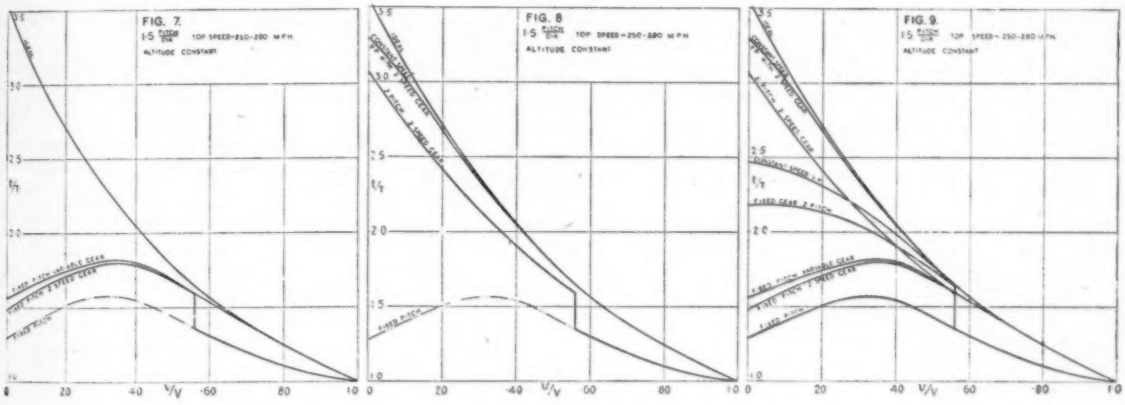
creases the static thrust of the 1.5 pitch 275 per cent. A 0.7*D* pitch airscrew would, generally speaking, be fitted to aircraft having a top speed of 110 m.p.h. The 1.5*D* pitch to an aircraft of 250 m.p.h.

Herein lies not only the reasons and justifications for variable pitch, but also the explanation for its late arrival. In the days of aircraft having airscrews with pitches less than their diameter, which, roughly speaking, means speeds of less than 150 m.p.h., variable pitch was not worth while. Not until aircraft of greater speed came into production was there sufficient incentive to attract the necessary capital for the development of V.P. airscrews. I think you will agree that an increase in static thrust of 13 per cent. would not have justified the increased weight, cost and complications. When speeds increased over this "no man's land" lying in the region of 150 m.p.h. the situation completely altered, and the conditions necessary to justify V.P. airscrews arose. As I have already shown, and as I shall emphasise more fully as I proceed, the consideration which so completely altered the outlook was blade stalling. The conventional idea that the object of variable pitch variable gear is to maintain constant engine r.p.m. is not sound. The real vital object is to prevent blade stalling. Any device which does not do this fails to justify itself.

blades are fitted with counterweights, and when the oil pressure is released the centrifugal turning moment on those counterweights is such that it overcomes the natural turning moment on the blades and forces them into high pitch setting. This method of operation has the advantage that oil pressure, with the possible troubles due to leakage, is only used for the relatively shorter period of flight in the low pitch setting.

The second case is illustrated by the Curtiss Wright. In principle, this is simple yet effective. The blades are rotated to any required angle, even negative angles, by a 36,000 to 1 gearing driven by a ¼ h.p. electric motor. In both the above types the pitch is set at the will of the pilot —in the case of the Hamilton to one of two pitches, and in the case of the Curtiss to any desired position. For both types automatic constant speed devices are being developed.

If I do not show or even briefly describe the Hele-Shaw Beacham variable pitch airscrew, it is only because it has already been fully described in a paper to this Society by Dr. Hele-Shaw in 1928. It is of the constant speed type, yet controllable in that the pilot can set it to run at any predetermined constant rate of rotation. Like the Hamilton, it operates between a minimum and a maximum pitch, whilst the Curtiss Wright can be set at any angle in the 360 deg. range, a feature with certain obvious advantages.



I have indicated an ideal airscrew. I want now to examine a number of more or less practical devices and to see how closely they approach this ideal. I hope to show that with some of them the ideal can be nearly realised.

(i) Two pitches—fixed gear.
(ii) Variable pitch—fixed gear.
(iii) Fixed pitch—variable gear.
(iv) Fixed pitch—two-speed gear.
(v) Two pitches—two-speed gear.
(vi) Variable pitch—two-speed gear.

For each combination I propose to confine myself to three airscrews with primary pitches 0.7, 1.5 and 2.5 diameters. These in practice correspond roughly to speeds of 110, 250 and 450 m.p.h. respectively, and two types of engine are considered:—

(a) Non-supercharged.
(b) Supercharged to maintain constant power up to, say, 20,000 ft.

(*a*) *Non-supercharged Engine*

(*i*) *Two Pitches—Fixed Gear, and* (*ii*) *Constant Speed Variable Pitch and Fixed Gear.*

The first case is well exemplified in the Hamilton two-pitch controllable airscrew. This device is a hydraulically-operated mechanism. Oil pressure plus the natural twisting moment moves the blade into its low pitch position. The

Having briefly referred to the actual mechanisms, let us examine the effect of the change of pitch in terms of thrust and aircraft speed. For purpose of illustration, I am assuming an airscrew having a primary pitch of 1.5 diameters corresponding roughly to a speed of 250 to 280 m.p.h. Note on Fig. 4 how the airscrews are working. A represents the designed conditions. The fixed pitch screw works along a torque curve from A to E. At low speeds it is working in the stalled region. The two-pitch works in high pitch along a torque curve from A to C. At C, which corresponds to a climbing speed between 0.55 and 0.6 of the level speed, the pitch is changed and the airscrew continues to work from climbing speed to static conditions along a torque curve shown by BD. You will note that in the static condition the change of pitch has not brought the screw out of the stalled region. The constant speed screw works along a constant torque curve ABF but just fails to avoid stalling. The ideal airscrew works along the torque curve shown as AGK completely clear of stalling.

Fig. 6 shows the resulting thrusts, both the two-pitch and the constant speed airscrews fall short of the ideal, but are marked improvements on the fixed pitch. Note the fall of thrust with the two-pitch, due to entering the stalled region near static conditions. The static thrusts are 1.29 for the fixed pitch, 2.18 for the two-pitch, 2.47 for the constant pitch, compared with 3.54 for the ideal.

There is evidence and also experience which leads one to think that the curves used are not fully representative

as regards static torque of full-scale conditions. But in order to arrive at any relative results it has been found essential to use some set of curves based on tests of similar blades.

If, as I admit is possible, the stalling point is somewhat more delayed and the static thrust higher under full-scale conditions, the various speeds I am quoting will alter, but the relative results will remain substantially the same.

(iii) Fixed Pitch and Variable Gear, (iv) Fixed Pitch—Two-Speed Gear.

There has from time to time been discussion as to whether a two-speed gear would constitute an alternative to variable pitch. The answer is definitely "No," because it does not prevent the airscrew blades stalling. The purpose of the two-speed gear is to allow the engine to maintain maximum r.p.m in spite of the airscrew running slower. The increase in power will slightly increase the airscrew speed and will result in an increased thrust, but this increase in the static rate of rotation causes the airscrew to commence stalling at an even higher speed than before.

Fig. 7 shows the improvement in thrust due to the use of a two-speed gear for an airscrew of 1.5*D* pitch (aircraft speed 250-280 m.p.h.). To make a fair comparison it is again assumed that the second gear will come into operation on climb at a speed between 0.55 and 0.6 of the top speed. The result compared with the two-pitch shown in Fig. 6 is scarcely worth the expenditure and weight involved. It forms no alternative to a variable pitch or a two-pitch airscrew, and the more difficult and complicated suggestion of a variable gear automatically changing to keep the engine revolutions constant is little better. The static thrust in the case chosen is 1.29 for the fixed pitch, 1.48 for the two-speed gear, 1.56 for a variable gear, compared with 3.54 for the ideal.

(v) Two Pitches—Two-Speed Gear, (vi) Variable Pitch Two-Speed Gear.

As an alternative to variable pitch there is no field for the two-speed gear, but it has a field, and for high-speed aircraft a very valuable field, as an addition for use with variable pitch. Indeed, I hope to show that by a combination of these two devices the ideal thrust curve can be closely approximated to.

In referring to the performance of the two-pitch airscrew, it was shown that for speeds of 250 m.p.h. or more, even in the second pitch, the blade would stall on the ground. In order to prevent stalling it is necessary to drop down to a pitch of 1.0*D* or less. To do this with the fixed gear engine would mean over-revving the engine on the ground. This could be prevented by introducing a second gear which would allow the airscrew to run faster to the necessary extent, but with the engine kept to its permissible r.p.m. For the case under consideration I have used a gear of 1.235, and thus have been able to drop down from a high pitch of 1.5*D* to a low pitch of 0.8*D*, a pitch which is well out of stall for all conditions of flight. An even better result would be obtained by using a higher gear and dropping to a still lower pitch, but there are obvious limits to such a procedure. The lower the second pitch the higher the airscrew revolutions, and either very high tip speeds would be encountered at low speeds (a condition in which high tip speed is most detrimental), or alternatively the primary rate of rotation would have to be correspondingly lower with consequently larger and heavier airscrews. In this particular case if the tip speed in the second gear is 900 feet/sec., then the tip speed in the designed condition will be 730 feet/sec.

Fig. 8 shows how closely these combinations approach the ideal. The static thrust of the fixed pitch, two-pitch two-speed, and ideal are 1.29, 3.06, and 3.54 respectively. To complete the story, note the thrust curve for the constant speed variable pitch with two-speed gear with its static value of 3.3, an increase of 256 per cent. over the ordinary fixed pitch and within 7 per cent. of the ideal.

The two-speed gear, together with variable pitch, has a further advantage. The airscrew runs in its top gear only for take-off and climb, but most of its flying is done in the low gear with a reduction of 20 per cent. in tip speed. Apart from improved efficiency, the airscrew will be less noisy, a point of importance for both military and civil aircraft.

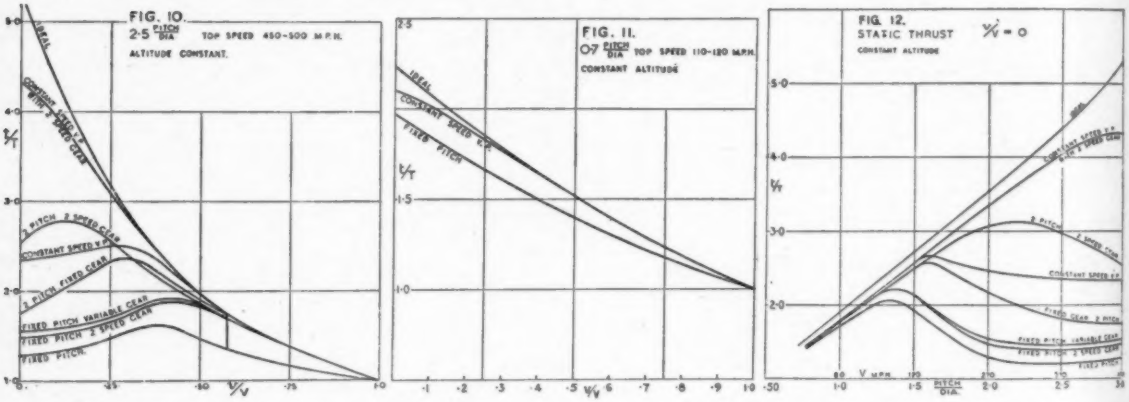


Fig. 9 shows the thrust curves of all the various combinations superimposed.

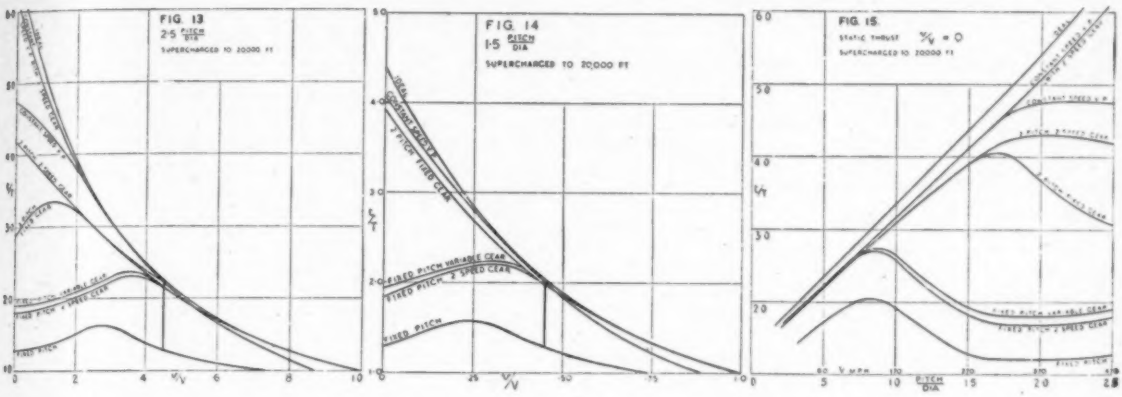
Fig. 10 shows similar thrust curves for the same combinations, but for an airscrew with a pitch of 2.5*D* corresponding to a speed of 450 to 500 m.p.h. The general order of merit remains the same, but their relative values have altered. All combinations except one are now stalling badly. The exception is the constant speed airscrew on the two-speed engine, which follows closely the ideal curve.

Fig. 11 shows the opposite end of the range illustrated by thrust curves for an airscrew with a pitch of 0.7*D*, corresponding to 110 to 120 m.p.h. In this case all the curves lie so closely together (and are not all shown), and so near the fixed pitch airscrew that, as previously stated, the gain to be obtained by variable pitch or variable speed is not worth the price to be paid.

The question of immediate interest is at what speed does variable pitch become worth while and at what speed may we expect the further addition of a two-speed gear to become desirable. This can best be answered by reference to Fig. 12, which shows the static thrust plotted against pitch. To give a more readily appreciated meaning, a scale of approximately corresponding speeds has been added. The fixed pitch airscrew designed for a top speed of 140 m.p.h. gives a static thrust equal to nearly 80 per cent. of the ideal. Whatever gain is possible can be obtained equally well with variable pitch or two-speed gear. Fig. 12 further shows that variable pitch, either in the two-pitch or constant speed form, only meets the full re-

quirements for a small range of aircraft with speeds of 140 to 200 m.p.h. Above 200 m.p.h. it falls well below the ideal curve. The two-pitch coupled with two gears continues to do well up to 300 m.p.h. Beyond this the field is held alone by the constant-speed type coupled with two gears. Above 400 m.p.h. even this combination shows signs of falling away. I have not thought it necessary to go farther, but should mankind ever fly at over 500 m.p.h.

for a pitch 0.7*D* was 87 per cent. of the ideal, for this supercharged 20,000 feet case it is 77 per cent. of the ideal. There is therefore a stronger case for the V.P. airscrew for low pitches. Further, as before at these low pitches, any of the combinations give much the same result which for practical purpose equals the ideal. Nevertheless, it still remains true that the gain at these low pitches is relatively small compared with the value of variable pitch



a demand will probably arise for three gears, if the present type of airscrew has not by that time been replaced by some other form of jet propulsion.

Let me make it clear at this point that my statements are only true and general when I confine myself to talking in terms of pitch/diameter ratio. I am translating these ratios into terms of miles per hour to give a more readily appreciated meaning of my remarks. The speeds given infer that normal tip speeds are between 800 and 900 feet per second. For engines geared to give lower airscrew tip speeds the general conclusions still apply in terms of pitch diameter ratio, but the figures in m.p.h. must be suitably altered.

Speaking, therefore, in terms of pitch diameter ratio, I would sum up generally for the non-supercharged or very mildly supercharged engine as follows:—

If the aircraft under consideration is or would be fitted with an airscrew having a maximum pitch less than its diameter, the value of fitting a variable pitch screw is very doubtful. If it has a pitch greater than its diameter it is worth while, and becomes more and more essential as the pitch increases. If the maximum pitch is greater than 1.3*D* a two-speed gear in the engine becomes desirable.

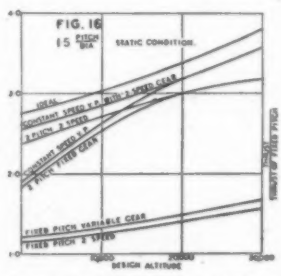
(*b*) *Supercharged Engine*

So far my remarks have been limited to non-supercharged or moderately supercharged and ground boosted engines. I now proceed to the case of the supercharged engine, and here again it has been found necessary, because of the variation in degrees of supercharging, to assume a hypothetical engine which I think does not so greatly differ from the average supercharged engine as to invalidate my remarks. The engine assumed is supercharged to give at 20,000 feet the same power as at sea level.

The airscrews considered are designed to run at low maximum engine r.p.m. flying level at 20,000 feet. Fig. 13 shows the thrust curves for an airscrew with a pitch of 2.5, and Fig. 14 for 1.5 diameter. The climbing speed at sea level is assumed as 0.45 of the top speed at 20,000 feet. Fig. 15 shows the static thrust at sea level plotted against pitch, and as in Fig. 12 a scale of speed assuming a tip speed of 850 feet/sec. is added. The thrust is expressed in terms of the thrust in the designed conditions, i.e., in terms of the thrust at maximum r.p.m. at maximum level speed at 20,000 feet. The first thing to note is that, whereas for the unsupercharged engine the fixed pitch static thrust

on the higher pitch screws. I think my previous conclusion still remains true that for pitches below 1.0*D* it is doubtful whether the cost of the V.P. is worth the gain. Above this pitch, or 140 m.p.h. at 20,000 feet, this doubt disappears. The two-pitch continues to give a static thrust closely approaching the ideal up to about 300 m.p.h., and the constant speed up to 330 m.p.h. Above this the two-speed gear with the constant-speed variable pitch becomes desirable, but the two-speed gear with the two-pitch airscrew is inferior to the constant speed with a single gear. Again, note the ineffectiveness of the two-speed or variable gear with a fixed pitch airscrew.

As compared with the non-supercharged engine, the main points to note are that variable pitch in some form becomes desirable at much the same pitch, i.e., approximately 150 m.p.h., but the two-speed gear does not become worth while until 300 m.p.h. or over, as compared with about 200 for the non-supercharged.



In Fig. 16 I have connected up the two cases, unsupercharged and supercharged, to 20,000 ft. The curves show for various altitudes of supercharging the ratio of static thrust with each of the various combinations to fixed pitch static thrust. The airscrew used for illustrations has a pitch of one and a half diameters, corresponding approximately to 250 to 280 m.p.h at the various altitudes. The main purpose of this Fig. is to show that there is an altitude of supercharging at which the value of the two-speed gear disappears altogether. For this particular airscrew it is approximately 18,000 feet.

Finally, I would say that it is one of the difficulties and dangers of talking on the performance of airscrews that there are so many variables and so many permutations and combinations. It is impossible in a limited set of curves to cover the whole range, and yet such a limited consideration leaves room for misunderstanding and criticism.

I trust, therefore, that in your criticism you will bear in mind the difficulties of presentation in a paper so limited in length.

TAPERED WINGS and SAFETY

Dr. G. V. Lachmann, A.F.R.Ae.S., Replies to Mr. W. R. Andrews' Criticisms of His Previous Article

MY article in *Flight* of January 2 on the stalling of tapered wings seems to have created the impression on Mr. W. R. Andrews (to judge by his article in *The Aircraft Engineer* of January 23) that the object was to paint a dark and pessimistic picture and then produce the slot as a *deus ex machina*. Presenting certain definite physical facts can hardly be compared with the painting of a picture. Besides, my short article never claimed more than to touch on certain aspects of the problem and the presentation of a particular technical solution which has been found to be practicable and to fulfil in full scale certain theoretical predictions.

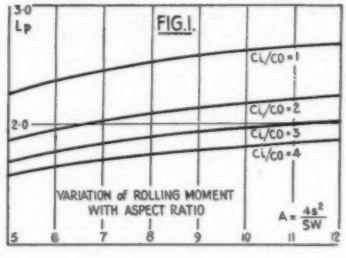
The object of my article was to show how the distribution of induced velocity across the span of a fully tapered wing, especially when the latter is fitted with a partial flap, can utilise to the fullest extent the beneficial aerodynamic characteristics of the slot. The result is a compound wing comprising all the advantages of high taper for normal flight combined with a high maximum lift and satisfactory stability in roll at and near the stall.

The second misapprehension on Mr. Andrews' part is that my article only considered wings having the same aerofoil section along the span, which limitation " is hardly in accordance with universal practice as far as cantilever wings are concerned."

The wing considered in my article—which has been subjected to wind-tunnel tests, theoretical analysis and full-scale trials—is not of constant thickness/chord ratio along the span, but quite " in accordance with the rules of general practice " it has been designed with a skeleton line of constant camber and thickness/chord ratio of 17 per cent. at the root and 10 per cent. at the tip. This wing is actually used on a certain type of service aircraft now in production.

I shall show later on that the influence of varying thickness/chord ratios is unable to alter noticeably the stalling characteristics of wings having higher taper ratios than $\lambda = 0.75$ and that sections of unusually high camber are necessary to produce a slight effect on wings of a taper ratio of $\lambda : 0.5$, which is the maximum taper considered by Mr. Andrews in his article.

A rather hair-splitting method has to be applied to not very reliable data (bearing in mind the elusiveness of K_L max.) in order to show off an improvement which, when expressed in definite units and compared with the effect of a slight rate of roll, melts away very rapidly.



For some reason, which I fail to see, Mr. Andrews connects maximum K_L with Km_0 (zero lift moment) as if maximum K_L were a function of the zero lift moment. Maximum K_L as well as zero lift moment are, of course, functions of physical parameters, namely, camber and thickness. However, this method of linking up K_L max. with Km_0 has at least the advantage of showing off certain structural consequences to which I shall refer later on.

It would appear that Mr. Andrews bases most of his conclusions—in regard to K_L max.—on wind tunnel tests obtained in the high-compression tunnel in U.S.A. It is well known, however, that these figures are not too reliable, because of the influence of turbulence. However, for the following discussion I shall accept these figures on their face value.

I find it a little difficult to follow Mr. Andrews' theoretical interpretations, and especially his remarks on damping in roll. Mr. Andrews chooses as a criterion for damping in roll the expression $K_L \times c$ which, of course, is the load per unit span.

Now, as far as damping in roll is concerned, the absolute loading is of no importance; what matters, of course, is the plan form of the wing and the slope of the lift curve $dK_L/d\alpha$ for infinite aspect ratio.

Damping in roll for a constant and positive $\frac{dK_L}{d\alpha}$ can be expressed by: $L_p = \int_{-s}^{+s} \rho v^2 \left(\frac{dK_L}{d\alpha}\right)_\infty . f_m \frac{p \, . \, x}{v} (C)_x \, . \, dx$

where: f_m = downwash factor according to Munk dependent on lift distribution and aspect ratio.

p = rate of roll.

C_x = chord at distance x from centre line.

The value of the integral for a trapezoidal wing with root chord c_i and tip chord c_o becomes:

$$L_p = \left(\frac{dK_L}{d\alpha}\right)_\infty . f_m . S \frac{s^2}{3} \left(1 - .5 \frac{1 - c_o/c_i}{1 + c_o/c_i}\right) \rho \, . \, v \, . \, p$$

In Diagram 1 the rolling moment due to roll has been plotted for wings of various taper ratios on the basis of constant span, area, forward speed and rate of roll.

The slope of the lift curve $dK_L/d\alpha$ has a constant value for any section quite independent of camber and thickness/chord ratio. The theoretical value is π and the actual value is slightly below this.

American results (N.A.C.A. Report No. 460) indicate a small influence of the thickness/chord ratio on $dK_L/d\alpha$; however, this effect is doubtful and may be due to other causes and in any case is negligibly small. It follows, therefore, that damping in roll below the stall, i.e., when the slope of the lift curve for each section is still positive, is always less for a tapered wing than for a rectangular one and the higher the taper ratio the smaller will be the damping in roll. This is really one of the advantages of the highly tapered wing from the point of view of controllability which has enabled large monoplanes with tapered wings to compete successfully with biplanes of constant chord. Apart from being impossible it would be quite absurd trying to develop a tapered wing giving the same degree of damping in roll as a straight wing.

The only reliable way of determining damping in roll for a wing near stalling incidence is to measure the rolling moment due to roll on a rolling balance for various rates of roll. The calculation of rolling moment due to roll near the stall, in other words, damping moment for a partially stalled wing, gives very hypothetical and unreliable results, because the influence of the rate of spreading of the stalled area is unpredictable.

I understand that tests of this kind have been carried out at the N.P.L. with wings of various plan form, and when these results are published they will shed more light on the problem in question.

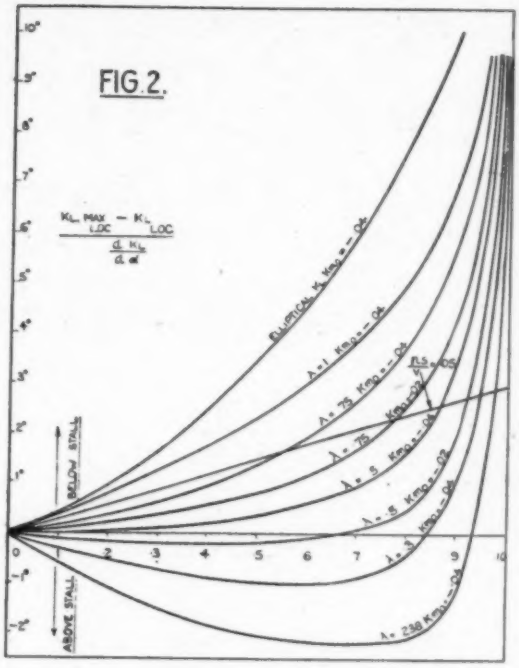
In discussing damping in roll one has to differentiate between the *degree of rolling* moment or the magnitude of rolling moment produced at a certain angle of incidence at a certain rate of roll, and the *angle of incidence at which, for a given rate of roll, damping becomes negative*. This latter point is of great practical interest because it indi-

cates the angle at which the aeroplane will drop its wing, and one is inclined to believe, at least as far as tapered wings are concerned, that this angle is identical with, or at least not far removed from, the one where stalling begins. The greater, therefore, the difference between the local K_L of any section at the outer portion of the wing compared with the local K_L max., the greater will be the margin between rolling stability and rolling instability. A rational criterion for determining where stalling is going to start first, is to determine the ratio of K_L local over K_L max. local or the difference between K_L max. local and K_L local.

Although Mr. Andrews expresses the opinion that a comparison on the K_L basis is misleading, I consider his diagram, Fig. 5, a more rational representation than his other figures, which are obscured by his bringing in the chord. (The misleading impression of diagram 5 results from comparing a tapered wing ($\lambda = .75$) of varying thickness/chord ratio along the span with a rectangular wing of constant thickness. When comparing tapered aerofoils with a rectangular wing on an equal basis in regard to the aerofoils used along the span, it is quite obvious that the rolling stability of a rectangular wing is always higher (see Fig. 1).) If one divides the difference between K_L max. local and K_L local by $dK_L/d\alpha$ one obtains a margin in degrees against stalling.

In diagram 2, curves are plotted for various taper ratios indicating the local angular margin against burbling. The curves were obtained by using calculated K_L distributions for the local K_L and Diagram 1 of Mr. Andrews' article in regard to local K_L max. Needless to say that negative values of $\frac{K_L \text{ max.} - K_L}{dK_L/d\alpha}$ have no direct physical meaning except that they indicate that burbling has set in. The straight line indicates the increase of local effective angles due to rate of roll $ps/v = 0.05$.

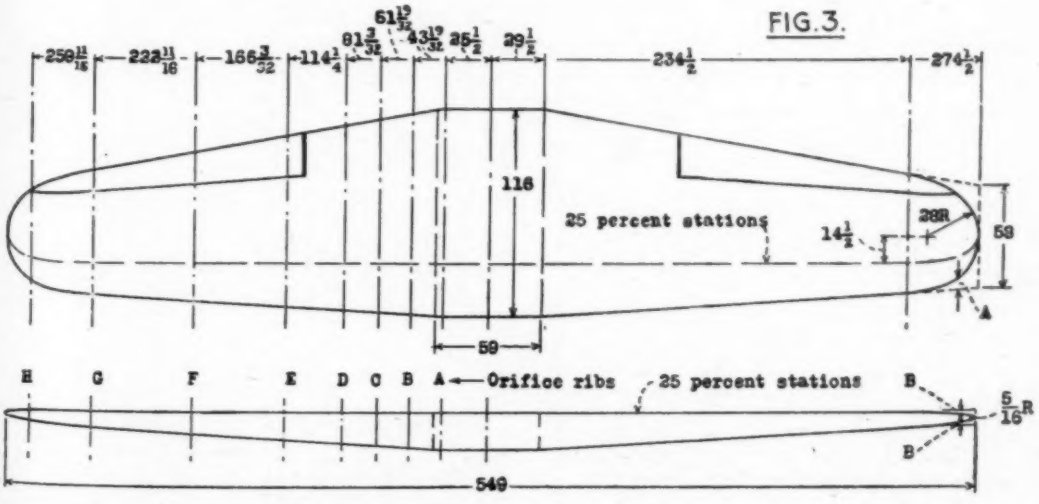
The taper ratios investigated are 1, 0.75, 0.5, 0.33, 0.238. One could have predicted without any further investigation that the aerodynamic characteristics of a wing of such a mild taper ratio as $\lambda = 0.75$ would obviously be not far removed from those of the rectangular wing. For a wing having a taper ratio of $\lambda = 0.5$ and using a section of high camber ($Km_o = -0.04$), stalling will begin at the centre for zero rate of roll. However, for rate of roll of $ps/v = 0.05$ (a magnitude which is usually introduced when interpreting measurements on the rolling balance in regard



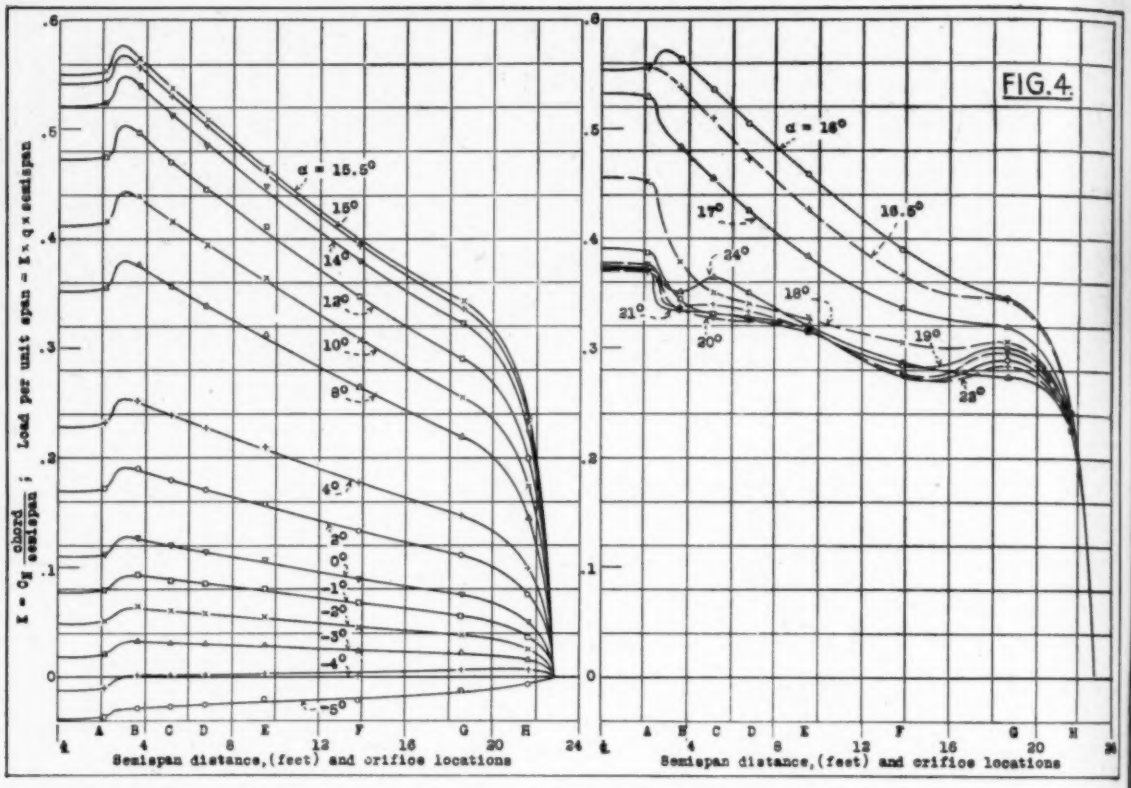
to roll in stability) the major part of the wing is stalled.

When using for the same wing a section of lower camber $Km_O = -0.02$, the wing will stall at zero rate of roll between centre and 0.65 of the semi-span. For a wing having a taper ratio of 0.33 and $Km_O = -0.04$, the wing stalls between the centre and 0.83 at zero rate of roll. For a wing with a taper ratio of $\lambda = 0.238$ and $Km_O = -0.04$, stalling will start at about 0.83 and will spread between the centre and 0.93s.

The diagram illustrates how the point where burbling starts travels from the centre of the wing towards the tips as the taper ratio increases. One is therefore inclined to predict that instability in roll will occur earlier as the taper becomes more pronounced.



U.S.A. 45 tapered aerofoil—plan form and orifice location. This illustration forms Fig. 1 of American N.A.C.A. Technical Note No. 521.



Semi-span load diagram of U.S.A. 45 tapered aerofoil, reproduced from Fig. 7 of American N.A.C.A. Technical Note No. 521.

The use of a wing section of very high camber has therefore only a beneficial effect for taper ratios equal to or below 0.5, but the margin against loss of stability in roll is very small and disappears already at very low rates of roll. When using a section of relatively low camber, which seems to be the more conventional method in practice, the wing will stall practically simultaneously over about two-thirds of the span in spite of the decrease in thickness/chord ratio towards the tips.

American Results

In this connection certain full-scale force and pressure distribution tests on a tapered wing of taper ratio 0.5 (see Fig. 3) are of interest. The tests are described in N.A.C.A. Technical Note No. 521, "Full Scale Force and Pressure Distribution Tests on a Tapered U.S.A. 45 Aerofoil" by J. L. Parsons, Washington, 1935 ($Km_0 = -0.02$). Fig. 4 shows semi-span load diagram at an average Reynolds Number of 4,183,000. The wing stalls at about 16 deg. and, as is evident from the diagram, stalls almost simultaneously between the centre and about 73 per cent. of the semi-span.

Although the advantage of using a section of very high camber is only very slight for taper ratios below $\lambda = 0.5$ and offers apparently no advantages at all at higher taper ratios from the point of view of stability in roll, it is not out of the question that the advantage may be a little more marked in full scale than would follow from the above theoretical investigation, because of the general delay of stalling.

However, the most serious objection to the use of highly cambered wings is the increase in zero lift moment and its consequences on structural weight. Usual values for Km_0 are of the order of -0.018 to -0.02. The proportion of the wing moment to the total moment at diving attitude is about 75 per cent. for low wing planes and 85 per cent. for high wing monoplanes. The highly cambered section may therefore put up the tail load by as much as 70 per cent. to 90 per cent., and, whatever the aerodynamical advantages in regard to stalling may be, the structural consequences due to nearly doubling the tail load are very serious, at least for aircraft which are to be flown at very high diving or fast glide speed.

In winding up the discussion, one general conclusion seems to be that for a design where slots are considered an unwanted feature, it is certainly wise to keep the taper ratio as low as possible in order to obtain a rolling stability not too different from the straight wing. However, I leave the question open whether the straight wing should be considered as a criterion for satisfactory rolling stability. Using a low taper ratio means, of course, giving up to a great extent the advantages in regard to lesser bending moments, greater effective spar height at the root for a given thickness/chord ratio, better lateral controllability and a higher aileron reversal speed for a given degree of torsional stiffness.

The Partial Flap

The effect of a partial flap on rolling stability has not been considered by Mr. Andrews, and he obviously misunderstood the meaning of Fig. 3 in my article, which does not refer to the maximum overall K_L. Judging from full-scale experience, the partial flap does not seem to have a great effect on the rolling stability of wings of very low taper ratio.

I agree with the Editor that there are quite a number of aircraft using tapered wing of low taper ratio which are fairly docile when stalled; their stall is usually of the falling leaf type. However, there is also very definite full-scale evidence on aircraft in this country and abroad which are not too pleasant when stalled as they drop a wing fairly rapidly, especially when the flaps are down.

Private Flying

Topics of the Day

Old Wives' Tales

IT very often appears to me that pilots, both amateur and professional, are just four times as temperamental as the most difficult film actress, and quite eight times as talkative as the most ardent fishwife. When three or four of them forgather, good aeroplanes and bad aeroplanes together stand a hundred per cent. chance of losing any merit which they might otherwise possess. And the effect is cumulative.

Mr. X, whose opinion is worth quite a lot, has only to drop the slightest hint about a minor vice to which a particular machine is prone, and all the Mr. Ys, whose opinions are not worth tuppence, proceed to enlarge on this vice and to exaggerate it until the machine appears to be little better than a flying coffin. All of which is very hard on the makers, who wish as much as you or I wish them to produce an absolutely perfect aeroplane. Unfortunately, aircraft design is a matter of compromise.

Non-existent Faults

EVERY machine that has ever been built has been credited with the oddest faults at one time or another. Only last week a pilot of considerable experience remarked that a certain machine flicked into a spin at the slightest provocation.

Curiously enough, I had, on the previous day, been practising spins on this machine, and, after applying full rudder with the stick right back, there was always a pause of three seconds at least before the machine took charge. The same pilot also asked me, in a hushed voice, whether I had ever held the Blank biplane up at the stall on full throttle "because a wing drops at once and its engine-on spinning characteristics are terrifying." I had—and noticed nothing out of the ordinary, though I am still prepared to find that the expert was right. When I have a chance I will try it again—at 3,000ft.

Now that the 1936 version of the D.H. Hornet Moth is out and about, it appears to be a good moment to quote the 1935 version as the prize example of a grossly over-criticised aeroplane. It was not perfect—no aeroplane ever is—and grandpapa could certainly not be allowed to go solo in it without previous instruction. It wobbled its wings rather irritatingly, but harmlessly, on the ground, and it did not react too favourably to bad landings. Nevertheless, I have made bad landings with it without breaking anything.

A Good Example

THE whole point was that, unless one felt confident enough to "pull a quick pint" (a satisfyingly apt metaphor) with absolute accuracy it was better to hold off with a fair reserve of speed. Most aeroplanes drop one way or the other if they are held off at five feet, and the 1935 Hornet merely dropped a wing with greater alacrity. A great part of the trouble may have been caused by the fact that the stick was off-centre, so that the newcomer tended to pull it back and to the left.

Nevertheless, a number of amateurs without a great deal of experience have been flying the Hornet at, for instance, the London Aeroplane Club, and, so far as I know, nobody has damaged it. In fact, the amateurs like it, while the professionals have become all grandmotherly about it. From my own experience I should say that, for once, the experts have gone wrong, and, at the very worst, the 1935 Hornet had virtues which far outweighed its little vices. Anyway, they cannot complain now.

This gossip business, of course, extends to the transport world, but there the unfortunate pilots must fly what they're paid to fly. There is at least one aeroplane, however, which has never become popular, largely because somebody or other said nasty things about it when it first appeared. Another transport aeroplane, I was always told, yawed steadily from side to side. I flew in one a fortnight ago. It doesn't. When flown by a human pilot the yaw is a matter of one or two degrees; when flown by Sperry is it not existent. Nor do the wings wilt in bumps to half the degree noticeable in other uncriticised aeroplanes.

Parachutes Again

SOME time ago I suggested that every club should hold one or two parachutes in stock for the use of members and instructors when they are expecting to do aerobatics at a height which would give each of them a chance to bale out.

Last week I did quite a fair amount of aerobatic flying with a parachute, and the feeling of security provided thereby was most marked. Probably the more timid of pilots would perform their little pieces with very much greater precision if their minds were entirely fixed on the job in hand. Because I always feel that flick rolls place undue strain on an aeroplane I refuse to do them. In any case, I only do aerobatics because I feel that, occasionally, at least, they are good for one's flying.

It is all very well to explain that the Sutton harness and its attachments are stressed for a load of a ton or so. When the straps bite into my shoulders my subconscious mind demands to be returned to the upright position almost immediately. For the first time, last week, I actually enjoyed the inverted position, and had no difficulty in resisting the temptation to get hold of something more substantial than the stick or the throttle. Straps *do* slip off one's shoulders occasionally and unnoticed in level flight, but parachutes rarely fail to open.

INDICATOR.

Private Flying

FROM the CLUBS

Events and Activity at the Clubs and Schools

LIVERPOOL

MOST of the flying during the three weeks ending February 21 was done during the week-ends. Actually the flying total was 82 hr. 30 min.

TOLLERTON

Flying time at Tollerton for the week ending February 20 was 11 hr. 45 min. Fog prevented flying on several days. Mr. R. G. Robertson did his "A" licence tests.

CASTLE BROMWICH

For the week ending February 20 flying times amounted to 7 hr. dual, and 8 hr. 45 min. solo. Cross-country flights were made to Coventry, Huil, Heston, Hanworth and Brooklands.

LONDON

Owing to the bad weather, the flying time at the London Aeroplane Club for last week was only 23 hours and 5 minutes. Messrs. N. Manby, S. K Reeves, and A. J. Moffatt made their first solo flights.

REDHILL

The bad weather reduced flying time at Redhill last week to 47 hr. 45 min. Mr. Urquhart successfully completed his "B" licence night flying test and on Thursday two triangular night flights were made from a flare path. There were three new members.

LEEMING

Mr. E. D. Chaytor has completed his "A" licence tests. Over 150 people were at the annual dinner-dance on Wednesday, February 12. Mr. T. C. Pick is away from the aerodrome doing his Reserve training course. Mr. Shand is taking delivery of his B.A. Swallow during the next few days.

PORTSMOUTH

The Portsmouth Aero Club is holding its first monthly forced landing competition on Sunday, March 1, at 2 p.m. Preparations are being made for the Club dance to be held at the Pavilion Ballroom, Clarence Pier, on March 20. Mr. W. B. Gerrard has become a member. The total flying time last week was 13 hr. 45 min.

BORDER

Due to minor faults, only one machine was operating during the week before last. Mr. J. A. Grant completed the tests for his "A" licence and the following became members: Messrs. F. G. Webster, G. E. S. Webster, R. M. Tabrum, F. K. Mayberry, G. Quarton, and L. T. Carruthers. One machine is being fitted up for blind-flying instruction.

YORKSHIRE

Machines of the Yorkshire Aeroplane Club flew 12 hr. 35 min. during the week ending February 14, and 14 hr. 40 min. during the following week. Another Moth, G-AALN, has been bought for the use of pupils, increasing the Yeadon fleet to six. Actually, there is one Short Scion, four Moths and one Puss Moth.

KARACHI

January's flying times totalled 230 hr. 50 min. A Hornet Moth has been loaned by the De Havilland Company. The ground staff has been busier than ever, and among its jobs was the streamlining of a machine for the Viceroy's Cup race.

C.A.S.C.

Ten members who attended the aerodrome on Sunday put in 3 hr. 50 min. dual, and 2 hr. 40 min. solo flying. After several plucky attempts to fly the *Pou-du-Ciel* with a Scott engine the machine went over on its back without injury to its pilot.

MADRAS

Wing Cdr. Crosbie has been demonstrating the Hornet Moth and left for Bombay on January 6. Messrs. Darius, De Silva, Sundararajan and Parthasarathy have gone solo, and Miss J. M. Strutton has become a member. The total flying time for January was 138 hr. 20 min.

CAMBRIDGE

Flying times have been seriously affected by fog, but, nevertheless, totalled 56 hr. 30 min. A charter trip was made in the Monospar, connected with an Imperial Airways machine arriving from Paris. The passengers reached Cambridge 45 min. after arriving at Croydon.

HANWORTH

First solos have been made by Miss B. Russell and Messrs. I. Jones and Turvil. Mr. C. Heath passed the tests for his "A" licence and Mr. Ker, having completed his blind-flying course, is now taking his instructor's course. Mr. Canas has also completed his blind-flying course. Flying times last week amounted to 27 hr. 55 min.

NORFOLK AND NORWICH

The Club had a good week of instructional flying and Flt. Lt. F. T. K. Bullmore was kept busy every day. Blind-flying is proving very popular with members and during the week Messrs. N. Brett, H. C. Harrison and W. O'Brien continued their courses. Another pupil—Mr. J. S. Edge of Norwich—commenced his flying during the week-end.

There was a good attendance at the supper dance held in the clubhouse last Friday evening. Another dance at the Club will be run in connection with the annual dinner which is to take place on Friday, April 17. The Club is shortly arranging a series of talks from members. The first evening will be shared by Lord Walpole and F/O. Bircham, whose subjects will be "Flying Across the American Continent" and "The Air Force's Work in India." On Sunday evening, Flt. Lt. Bullmore continued his series of lectures, his subject being "Airmanship." Next Sunday the instructor will deal with "Navigation."

Although the schools have not yet been informed of the arrangements for this year's Public Schools Aviation Camp, three applications and reservations have already been received.

SOLO TRAINER: A climb of 3,280 ft. in 3 min. and a top speed of 142 m.p.h. are achieved by this new German single-seater trainer, the Bücker Bü/33. The engine is a 140 h.p. Hirth. A description appears on the following page.

ROYAL AIR FORCE

Air Commodore W. S. Douglas, M.C., D.F.C., recently joined the Royal Air Force Flying Club.

BRISTOL AND WESSEX

The Bristol and Wessex Club's aviation ball, which was to have been held on February 28, has been postponed, and the new date is Friday, April 24. The ball will be held at the Grand Spa Hotel, Clifton.

Mr. L. R. Williams, who has been with the Club since 1930, has now been appointed secretary. Mr. A. Bailey has joined as a pilot member and Mr. Wingate-Hill made his first solo flight during the week. Sixteen hours were flown during last week.

SOUTHEND

School work came to a standstill two week-ends ago, but over six hours' instruction was given during the week ending February 17. New members include Messrs. Barry Ford, E. L. Hill, J. L. Hendrie, A. D. Hopkins, and W. Dean. Alterations are being made to the clubhouse to provide a new members' dining room which will be opened on March 1.

Bad weather stopped all flying again on Saturday, February 22. On this day, incidentally, F/O. Longfield joined the Club as instructor and put in 5 hr. 55 min. dual on Sunday. The Club has been visited by Mr. Kronfeld with the Super-Drone and by pilots from Hanworth, Broxbourne, Heston and Croydon.

READING

The thirty-four pupils at the Reading training school have made the most of the fine weather and the majority have gone solo. The large extension to the service hangar is now nearly completed.

A Falcon VI left the works by road this week to be shipped to South Africa, and a Hawk Major, resplendent with R.A.F. markings, left the aerodrome for an R.A.F. station.

CINQUE PORTS

Bad weather was again responsible for rather low flying hours at Lympne last week. Mr. Hudson, who came down from Croydon, in a Monospar, to do the return trip after dark for his "B" licence, pulled off an excellent forced landing in a field not far from the aerodrome. He arrived just after sunset when a mist appeared and in fifteen minutes the aerodrome and the neon light were completely obscured. He put down under most difficult circumstances in the only field that remained visible. The services of the Club's ground staff were placed at his disposal, and the Monospar was towed up to the aerodrome. The rough surface, and the small size of the field made it inadvisable for the machine to be flown out. Later in the evening the mist cleared, and Sgt. Pilot Cross, of No. 25 Squadron, did his night flight from Croydon in the Club's machine. Cross is taking his "B" licence before leaving the Service in a few months' time. Mrs. Macdonald, the owner of a black Hawk Major, has commenced instruction for her "B" licence, and is doing a lot of flying both on her own machine and the Club's Tiger Moth.

For Solo Training

GENERALLY speaking, the latest Bücker single-seater trainer, the Bü/33, is similar to the better-known Jungmann two-seater, being a braced biplane with a pronounced sweep-back and interplane struts of "N" formation.

Each wing has two wooden spars of "double T" section, wooden ribs and fabric covering. The welded steel-tube fuselage is faired to an oval section and is also covered with fabric. Ailerons are provided on all four planes, and the elevator—which, like the other members of the tail unit, is of steel-tube construction—has trimming tabs.

Of the divided type, the undercarriage incorporates spiral springing and oleo shock-absorber struts. The spring tail wheel can be interconnected, if desired, with the rudder.

One of the new Hirth HM6 inverted air-cooled six-cylinder engines of 140 h.p. at 2,300 r.p.m. is specified and gives a maximum speed of 142 m.p.h.

Empty and loaded weights are, respectively, 903 lb. and 1,289 lb. The climb is excellent, 3,280ft. being reached in 3 min.

Haig

Haig, by Duff Cooper (Faber and Faber, Ltd., 25s.).

THE first instalment of the life of Earl Haig, by the present Secretary of State for War, is a fine study of a great man, and is also a most readable book. What is rather surprising is that, although one of the most notable developments of the Great War was the rise of the Air Arm and the great part which it came to play, there are very few allusions to it in the biography of the British Commander-in-Chief. There are, in fact, four passages in the volume dealing with the part played by aircraft. During the retreat from Mons a French officer was sent to take a message to Sir Douglas Haig, and when he found him he was receiving a report from a British airman who had seen an important movement by German troops. During the battle of the Aisne Haig wrote in his diary: "I arranged practice to be carried out with an aeroplane helping to direct the guns to-day against one of the enemy's concealed batteries." The author adds the comment: "Many of the older officers, who had been slow to appreciate the importance of the air arm, were still reluctant to make full use of the invention, but Haig's mind was never stereotyped, and from the first he had given the greatest encouragement to the pioneers in military aviation, and he was eager to discover fresh ways of utilising their prowess."

On the eve of Neuve Chapelle (March, 1915) Haig interviewed for the first time "Major Trenchard, who commands the Flying Wing under my orders." It is added that Major Trenchard was much impressed by Haig's full appreciation of the Flying Corps. In May of the same year Haig discussed his requirements with an official of the Ministry of Munitions, and among other things remarked that "Captive balloons are required to supplement aeroplane observation."

The fact is that this book is a study of Haig the man rather than a critical history of the war on the western front, and aircraft, like other things, are only mentioned incidentally in order to show the workings of Haig's mind. Tanks receive considerably more notice, because discussion of Haig's use of them is still raging.

Aid for Indian Clubs

THE Government of India has agreed to extend the grant of financial assistance to flying clubs in India for a period of three years with effect from April 1, 1936. Hitherto the Government grants to clubs have been given every year, but there was no guarantee that the subsidy would be renewed at the end of that period.

Thus, in a state of uncertainty, clubs could not undertake any ambitious schemes of improvement. The grant to each club will be Rs.20,000 a year, while the amount of a fixed subsidy which can be earned by any club will vary according to the number of machines maintained, though every club will have the opportunity of earning the same maximum subsidy. At the end of three years the subsidy will either be discontinued altogether or, if continued, will be on a substantially reduced scale.

TWO WRIGHTS . . . A pair of new de luxe equipped Whirlwinds—a seven-cylinder model rated at 320 h.p. and a 450 h.p. (take-off) type—are claimed by their manufacturers to enable the "smaller" operator to enjoy the benefits of their air transport experience. The new engines have "dynamic dampers" special drives for the operation of generators, a vacuum pump for actuating navigation instruments, mechanism for a hydro-controllable airscrew, complete radio shielding, pressure baffling and automatic valve gear lubrication. This picture is of the Whirlwind 320, which is of 760 cubic inches displacement. The higher-powered engines are nine- and not seven-cylinder radials.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for publication in these columns.

"COMMERCIAL EFFICIENCY."

I APPRECIATE Mr. Bentley's and Mr. Brown's replies to my letter on the subject of Mr. Bentley's formula, and I agree there are one or two points which require clearing up.

Mr. Brown points out that the Monospar should be taken as a three-passenger machine, and that I refer to the fact that the number of passengers should be taken as inclusive of luggage accommodation. I merely referred to Mr. Bentley as quoting the number of passengers which can be carried in ordinary air-line work when the 'plane is equipped with luggage and lavatory accommodation to illustrate that this equipment is not usual on single-engined aircraft. I agree that if the question of luggage is to be taken into consideration in connection with Mr. Bentley's formula the Monospar should be shown as a three-passenger machine, in which case the Falcon, which tops the list for "Commercial Efficiency," must be declared as a two-passenger machine, and its "commercial efficiency," based on two passengers with a top speed of 140 (not 148), is reduced from 6.415 to 4.154; thus, instead of heading the list, the Falcon becomes No. 6 in the table. The maximum loaded weight for the Falcon is, I understand, a pilot, three passengers, and thirty-two gallons of petrol, with no allowance for luggage. This rather upsets Mr. Brown's reference to the remarkable "commercial efficiency" attained by the Miles aeroplane. Incidentally, I thought I had covered myself when describing the Monospar as a four-passenger machine by stating that the calculations were based on the other figures in the table.

Taking the Merlin as a four-passenger machine, surely its top speed should read 155, and the h.p. 200, thereby reducing the "commercial efficiency" factor to 5.524 against 5.792. The figures for the Peregrine are estimated, and as the machine has not yet flown and is still in its experimental stage, I suggest that it should not be included in the table.

Naturally, I agree that the single-engined machine scores heavily on the question of maintenance cost of engines and airframes, and time lost due to overhauls, etc., but Mr. Bentley makes it clear in his table that his definition of an air-line machines does not include single-engined types.

As regards the question of metal *v.* wooden construction: on the maintenance side I find that engineers with experience of both types of construction are strongly in favour of metal, both as regards the cost, time and annual depreciation. I appreciate that this factor is governed to some extent by the place and conditions under which aircraft are operated. Mr. Bentley agrees that metal structures are more durable, but points out that wood is more easily obtained and repaired than high-tensile steel or special Dural sections. Here again I agree with Mr. Bentley, but surely this seems to point to my suggestion that his formula is not practicable because it does not cover these debatable items.

Again, Mr. Bentley draws attention to the fact that his critics appear to assume that the prospective air-line operator is an unintelligent nitwit who will use his formula without taking into consideration any other characteristics of the aeroplane. I still maintain that the most important thing for the commercial operator is the cost per machine mile, if the air-line operator is bent on operating his machines on a commercial basis—therefore at a profit.

I must confess that I cannot evolve a better formula than Mr. Bentley's, but I do suggest that a formula for arriving at a cost per machine mile is of far more use to the prospective air-line operator—nitwit or not—than a "commercial efficiency" formula which might mislead instead of guide.

Hanworth. S. J. NOEL-BROWN.

THE SCANDINAVIAN ROUTE SUBSIDY.

YOUR "Outlook" paragraph, "The Scandinavian Airway," on page 191 of last week's *Flight*, quoting my letter of the same issue, seems to go far to prove my point that one company out of two has been unfairly treated.

You say: "The suggestion that official favours ought to have been distributed between two companies instead of being concentrated on one" is not "easy to support." On the very precedent you then go on to quote that of 1923, just before Imperial Airways was formed, it would seem to be not only easy, but almost necessary to support this suggestion.

"It will be remembered," you say, "that before 1923 there were three subsidised companies flying across the Channel." What were these subsidies except official favours, equally distributed?

If amalgamation is desired in 1936, why should not the two firms concerned be as equally and fairly treated as three were in 1923? Then, after a period of subsidised operation, the firms were called to the conference table by an impartial Air Ministry, and they met on equal terms, so far as "official favours" were concerned.

Now the stage is set very differently, for a far from impartial Air Ministry will sit at the head of the table, having armed one party with weapons wherewith to enforce amalgamation terms and having carefully disarmed the other party in advance.

If the end justifies the means, however unfair those means may be, and if wasteful competition is to be eliminated by crushing one competitor out of existence, let us say so frankly. No excuse for such a course would be needed in a dictator-ridden country, and why should we seek to find one here, if our authorities are to set up in this line of business?

The only trouble is, will the desired effect be obtained, or have the authorities blundered in under-estimating the strength of those they attempted to destroy?

Time will show. OUTSIDER.

London, W.1.

ROYAL AERO CLUB OFFICIAL NOTICES

AIR NAVIGATION BILL.—The Royal Aero Club, represented by Major A. Goodfellow and H. E. Perrin, appeared before the Parliamentary Air Committee at the House of Commons on Tuesday, February 11, and explained fully the various amendments which the Club would like to be made in the Air Navigation Bill.

These views were put forward on behalf of the Royal Aero Club, the General Council of Associated Light Aeroplane Clubs, British private owners, the Aviation Section of the A.A., and other bodies.

The object of the desired amendments is to protect aircraft users against undue liabilities and penalties as compared with other forms of transport.

International Air Rallies Abroad.—The Club has been notified of the following International Air Rallies:

Whitsun flight through Austria, Hungary and Switzerland, organised by the Austrian Aero Club, Vienna; May 27-June 4.

Aerial tour of Czechoslovakia, organised by the Czechoslovakia Aero Club, Prague; June 6-14.

Week-end Aerien in Hungary, organised by the Aero Club of Hungary, Budapest; September 5-6.

A cordial invitation is extended to all British private owners to take part in these events. Intending participants are requested to communicate with the Royal Aero Club, 119, Piccadilly, London, W.1.

HAROLD E. PERRIN, Secretary.

Aeronautics at St. Dunstan's

A HUNDRED men who had not seen an aeroplane since the days of the Great War, though they had lived in this country ever since that time, formed the audience at a lecture given last week by Air Comdre J. A. Chamier. They were war-blinded men of St. Dunstan's, and they followed with the greatest interest the lecturer's description of the enormous strides made in aviation after the War.

He explained how aeronautical history was repeating itself, though in a very different form, in the use, for example, of the catapult for launching aircraft and in the revival of the monoplane. Afterwards his audience were even better able to appreciate the progress of aeronautical engineering by being allowed to pass their hands over models of modern aircraft and thus to obtain a very good idea of their design.

HERE and THERE

Car Firm's "Pou" Engine : A Private Owner Broadcasts : New V.P. Airscrew

For the Light Brigade

PRODUCTION of a light engine, suitable for *Poux* and similar craft, is about to be started by the Alta Car and Engineering Co., Tolworth, Surrey, makers of the Alta sports and racing cars.

This Alta engine is an air-cooled flat-twin, the cylinders being slightly offset to allow for a two-throw crankshaft. Cylinders and crankcase are cast in one piece, of Elektron alloy, the cylinders having steel liners. The bore and stroke are 95 by 100 mm., giving a capacity of about 1½ litres. Aluminium cylinder heads are used, having alloy-bronze valve seatings. They are ground to mate with the barrels, no gaskets being fitted.

The pistons are of slipper type, in aluminium alloy, and the steel connecting rods are fully machined. There are two valves per cylinder, set vertically in the heads, and operated by push-rods and rockers from a camshaft in the crank case. An Amal carburetter is mounted at the back of the crank case, feeding *via* external piping. Alongside it, on the port side, is a Watford magneto, driven directly from the camshaft. Dual ignition can be supplied if desired. The crankshaft runs on a ball-race at the front and a plain bearing at the rear, the ball-race taking airscrew thrust (the airscrew is directly driven) and having an ample margin of safety. The big-ends are plain. Valves and springs are completely enclosed.

A striking and practical feature is the provision of a streamline outer cover for the crank case, in Elektron alloy. This extends rearwards and encloses the carburetter and magneto, terminating, when the engine is intended for a *Pou*, in an oil-gauge, the dial thus being right in front of the pilot. This cover protects the magneto and enables the carburetter to inhale warm air. With a compression ratio of 6.5 to 1, the Alta engine develops 36 b.h.p. at the normal cruising speed of 2,800 r.p.m., and it can safely run up to 4,000 r.p.m. for take-off, when it produces 47 b.h.p. The weight, with carburetter, magneto and lubricant, is 90 lb.

Based largely on the 2-litre Alta racing car unit, the engine has been extensively tested. An experimental unit of 980 c.c. was originally constructed and the production engine evolved from it. The Alta engine will probably be presented for an Air Ministry type test, and production examples will probably be run for an hour at 4,000 r.p.m. before delivery. The price has not been finally decided upon, but it should be competitive.

An Air Tourist on the Air

FULL marks to Major R. H. Thornton, who, on Tuesday of last week, opened the B.B.C.'s new series of eight aviation talks with a masterly dissertation on "Cheap Speed."

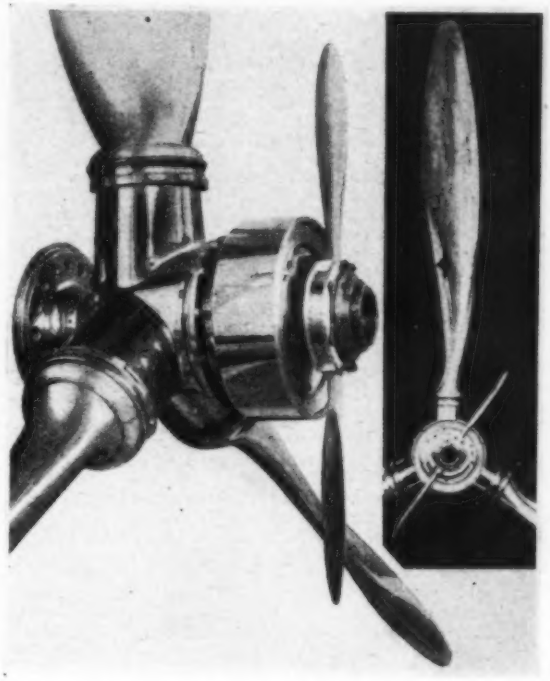
One does not ordinarily see a complete family, womenfolk included, listening with genuine interest to any B.B.C. talk on a specialised subject; but we saw such an exception during Major Thornton's talk, so compelling was his microphone manner—and this particular family was not one at all closely connected with aviation.

He refused to indulge in the sweeping generalities, born of over-enthusiasm and so beloved of many who talk aviation to the general public; he did not attempt to suggest that flying was cheap, but merely that it was cheap when one put speed foremost, supplementing his remarks by some cogent facts and figures obtained on air tours which, in company with his wife, he had undertaken as a private owner.

Passing on to the subject of the private air tourist and his relation to commercial air traffic in fair weather and foul—in which he drew the accurate parallel of the private owner of a small yacht—he concluded with some pungent observations on air touring restrictions . . . "the first thing you discover when you take an aeroplane abroad is that every politician in the world is determined that the air shall not be free."

Major Thornton also set some posers, on the subject of air defence, for future speakers in the series.

Last Tuesday evening Capt. J. Laurence Pritchard was down to speak on "The Designer's Task," and next Tuesday, March 3 (National, 10 p.m.), Mr. Ivor McClure, of the Air Ministry, is to tell us about the problems of "Making Flying Safe."



RATIER'S LATEST : A small windmill operates the pitch-changing mechanism of the three-bladed Ratier airscrew, which, as reported last week, has a hollow centre to allow the passage of *moteur canon* shells. When the windmill speed drops below the airscrew speed, the pitch changes into the fine setting and *vice versa*. Thus on climb the pitch changes down, and in horizontal flight it changes up.

A Tutorial Occasion

THE British Institute of Engineering Technology and the British Tutorial Institutes held their eighth annual dinner in London on Tuesday of last week, attended by an amazing number of experts in the equally amazing diversity of subjects taught by these two bodies. The B.I.E.T., which, incidentally, has lately moved into very up-to-date and commodious accommodation in Stratford Place, London, W.1, is of particular interest to those aeronautically inclined, because it instructs for such examinations as those for ground engineers' and pilots' B licences, air navigators' certificate, and qualification as A.F.R.Ae.S. and A.M.I.Ae.E. Its courses are approved by the Royal Aeronautical Society.

Mr. F. L. Cowham, proposing "The Institutes," gave some idea of the scope of the courses offered, and mentioned branches which have been established in South Africa, India, Australia and Canada. Mr. Harry Hum, responding, gave the following statistics: Last year 16,443 students enrolled for courses—an increase of over 2,000 compared with 1934 (the figure excludes enrolments from colonial branches); from these latter there were 2,587 students—about twice as many as in the preceding year; and there were 65 passes in the examination of the Institute of Electrical Engineers, 47 in that for the Institute of Mechanical Engineers, and 56 passed for the Institute of Electrical Engineers. Numerous other passes were recorded in other branches.

Professor A. M. Low made a typically witty speech in proposing "The Ladies," to which Miss M. Watkin responded.

In the absence of Mr. Hal Hill through illness, Mr. Drake proposed the toast of the Chairman (Mr. J. J. Cleaver), who, in the course of his response, read congratulatory cablegrams from the overseas branches. He also revealed that branches may soon be opened in New York and Palestine.

THE B.I.F. REVISITED

Some Further Notes on Exhibits of Interest to the Aircraft Industry

IN *Flight* last week we spoke of the growing interest industrialists are taking in aeroplane work and how this was demonstrated in the displays at the Birmingham section of the British Industries Fair. It is impossible, in a brief visit, to take in all that there is to see; there is so much that is interesting that, without wishing it, the visitor gets sidetracked very easily.

However, strict attention to duty and a systematic survey of the stands reveal much that commands the attention of all whose interest lies in the production of aircraft and the equipment of aerodromes.

Nuts and bolts are not very exciting in the ordinary way, but Charles Richards, of Darlaston, Staffs, show what they can do when they get down to it, and have produced varieties of these parts to specification for aero engines and aeroplane construction. Then, T. J. Priestman, Ltd., of Birmingham, have a gigantic display of metal ingots in all kinds of alloys, extruded billets, brasses, bronzes and bearing metals. In a varied show of tubes, sections and drawn pressings, Serck Tubes, Ltd., Birmingham, include a number of radiators, an aeroplane radiator being prominent.

Quite a different class of work is shown by Voucher, Ltd., Walsall, who have some beautifully made small machine tools specifically designed for aero work and other precision jobs.

At the top end of the building is the stand of the Autoset Clamp Co., Ltd., Birmingham, where are displayed all manner and sizes of castors. These are chiefly for industrial trucks and similar purposes, but there is a new design on a larger scale that is being developed for use as a tail skid.

The firm of Avery, known throughout the world for weighing machines, have some very special appliances, among which is a machine for checking the balance of airscrews. There are also hardness-testing, tensile and compression-testing machines, valve spring testing apparatus, etc.

Some exquisitely made little tools, tensometers, precision testing machines and the like are shown by the Birmingham Tool and Gauge Co. Jenks Brothers, Ltd., Wolverhampton, have a very comprehensive exhibit of spanners of all kinds and some interesting split pins with a double head, the lower head fitting in the castellation of the nut and the upper one protruding so that it may readily be grasped when it is desired to remove the pin.

Nuts that "Stay Put"

As their name implies, Simmonds Aerocessories, Ltd., devote themselves entirely to aero work. Not the least interesting in this display is the Simmonds elastic stop nut, which, through the medium of a fibre collar inserted within the head of the nut, is automatically locked on to the thread of the bolt and will not come adrift except under the influence of a spanner. Several of these nuts are undergoing a vibration test continually throughout the day, and although the vibration is heavy the nuts show no signs of moving. Then there is the Simmonds-Corsey transmission, a flexibly jointed device for push-pull control work, capable of transmitting heavy loads and having a minimum of backlash.

A useful little appliance for factory or aerodrome is shown by the Steel Nut and Joseph Hampton, Ltd. It is a mechanic's metal cabinet in which tools may be stored or held ready for use during repair work.

At another end of the scale are the motor mowers made by Charles Pugh, Ltd. There are models capable of dealing with all classes of work.

More tubes and sections are shown by Accles and Pollock, the well-known Midland firm, who are capable of dealing with any problem involving the use of tubes.

Then, Turner's Motor Manufacturing Company, who are shortly to be established in a new factory at Wolverhampton, have on view examples of the pneumatic landing legs recently described in these pages.

Gears of every description are grouped on the stand of Moss Gear Co., Ltd., Tyburn, Birmingham, who also make a speciality of aircraft precision parts.

All about the building are numerous clocks, the work of Gent and Co., Ltd., Leicester. Their stand presents a fine array of electric impulse clocks, fire alarms, call systems and indicators of all descriptions.

A series of large photographs on the stand of Birmingham Electric Furnaces, Ltd., illustrate some large installations of electric furnaces. There are also examples and models of melting and tempering furnaces for the production and heat treatment of metals.

Modernity is typified in the buildings at many airports and landing grounds, and how this effect may be achieved is well demonstrated in the display of Henry Hope and Sons, Ltd., Smethwick. Steel and bronze windows, roof glazing, electrically controlled window opening gear, and pressed-steel door frames are all shown, while on the neighbouring stand of Hope's Heating and Lighting, Ltd., are many types of central-heating apparatus.

In the same category are the Eclair balanced doors made by Hawkes and Snow, of Shirley, Birmingham. These doors are made in one piece, and there is scarcely any limit to the size that can be constructed. They demand the minimum of effort in their operation and, since they open upwards and lie flat along the ceiling, they do not occupy valuable room when they are open.

The rust-proofing of steel by the Sherardizing process is demonstrated by the Zinc Alloy Rust-proofing Co., Ltd., Wolverhampton, and small test samples, half of which are treated and half not treated, may be obtained and tested.

Springs, and appliances involving the use of springs, are shown by George Salter and Co., Ltd., West Bromwich, whose products are extensively used in the aircraft industry. They include aero engine valve springs of the type that have been used in engines employed on a number of successful long-distance record flights.

Not-so-Lethal Weapons

At first glance, it appears that the exhibit of Accles and Shelvoke, Ltd., Aston, Birmingham, is devoted to appliances for the slaughter of animals, but there are also aircraft accessories, which include flare signal pistols and such-like items.

Lewis Berger and Sons, Ltd., Homerton, London, are, of course, well known in the paint business, and their productions include all manner of finishes, cellulose and synthetic enamels, plastic paint, and all types of decorative and protective finishes.

A similar exhibit is that of Cellon, Ltd., Kingston-on-Thames, whose aircraft dope needs no introduction. They also show cellulose lacquers for metal, leather, wood and fabric.

Various examples of Uralite fireproof sheeting and Asbestone (asbestos-cement) are on view at the stand of Cellactite and British Uralite, Ltd., High Holborn, London, W.C.1, together with Cellactite asbestos, protected metal roofing, roof ventilators, and so on.

An interesting demonstration is that given by the British Oxygen Co., Ltd., London, S.W.1, who are showing oxy-acetylene welding and cutting plant, oxygen cutting machines for cutting steel shapes and sections, acetylene flare lights, metal spraying equipment, and sundry other items.

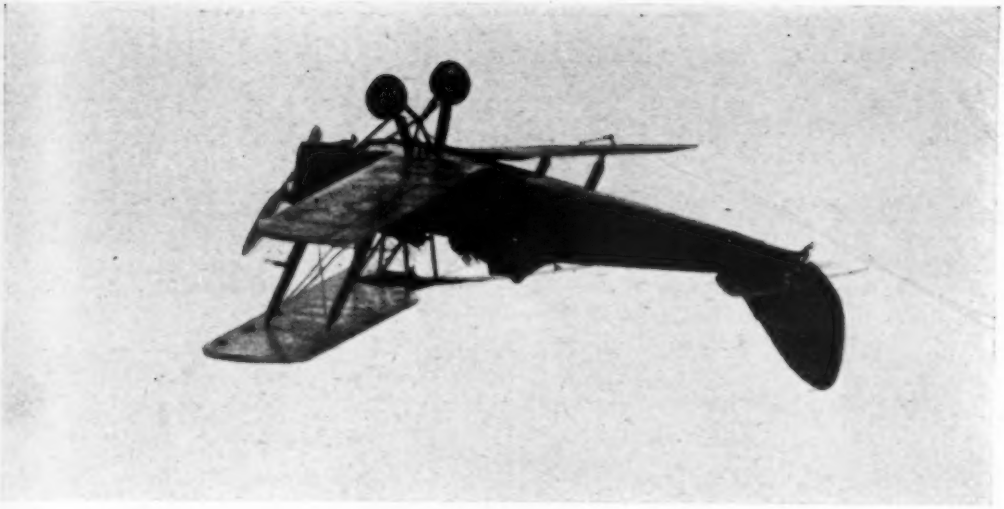
Motor spirit from coal is an industry which, undoubtedly, will assume larger proportions in this country in the near future. How National Benzole is produced from British coal is shown on the stand of the National Benzole Co., Ltd.

Tecalemit, Ltd., Brentford, have on view an immense variety of lubricating equipment, including grease-gun systems and mechanical lubricators, while there are also air compressors, aircraft fuel pumps and filters, and shock absorbers. A similar exhibit in many ways is that of C. C. Wakefield and Co., Ltd., displaying a variety of lubricating equipment, tyre inflation appliances, mechanical lubricators, grease lubricators and the like.

Steels of every description in bar, strip, wire, sheet and special section form for aircraft work are shown by the United Steel Companies, Ltd. James Walker and Co., Ltd., Woking, show packings and jointings for all pressures and temperatures of steam, fluids or gases.

All the types of pistons and piston rings with which their name has become famous are on the stand of Wellworthy, Ltd., Birmingham. They include floating-boss and Welflex compensating pistons, compression and scraper rings, Superslot oil control, and Simplex rings and "Surelock" valve seat inserts.

By the time the earnest visitor has seen all these he will be feeling a little tired; yet what has been roughly touched upon above is only a fraction of this intensely interesting exhibition—which, incidentally, concludes to-morrow.



This is probably the first photograph ever taken of a machine on its back with the pilot—in this case Flt. Lt. H. A. Howes—by himself and under the hood. (*Flight* photograph.)

BEHIND the GYORIZON

In the Air with the Latest Reid and Sigrist Instrument : Aerobatics Under the Hood

SINCE the original "invention" of instrument flying and the standardisation of suitable instruments in all transport aeroplanes, the discussions on the relative merits of free and restrained gyros have been many and tedious. Of these systems the free type may be epitomised as an artificial horizon and the restrained type as a rate-of-turn indicator. The best answer to all arguments is given in the fact that, while pilots of big machines generally prefer to fly on free gyro instruments, international conventions have insisted that a restrained gyro instrument must be fitted.

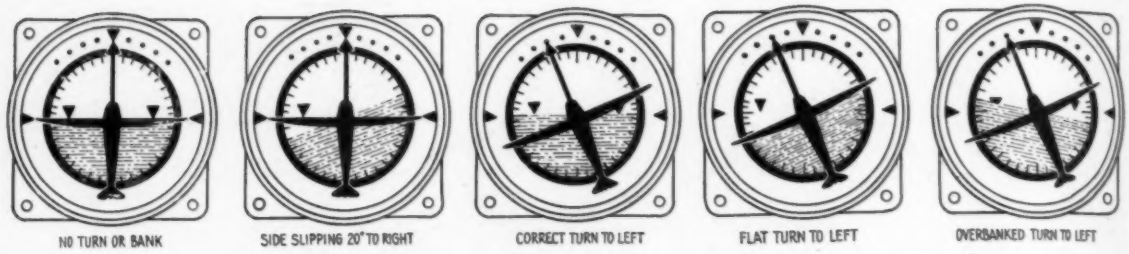
It might be said that the Gyorizon has been produced in order to combine, to some extent, the advantages of both, but this is by no means the whole story. It is simple to follow, functions in all possible attitudes and is also comparatively inexpensive in production.

Briefly, the Gyorizon is a combination of a normal rate-of-turn indicator with a visible horizon consisting of a coloured liquid which has been tested to remain liquid down to -60° C. By the simple expedient of allowing a pair of wings to sprout at the pivot point of the turn indicator needle the lateral relation of the machine can be represented against an imaginary horizon. Since this horizon is itself affected both by gravity and by centrifugal force, the pilot is given an easily understood *diagrammatical* picture of the angular motion as well as of the attitude of his machine.

The actual effects will be more clearly understood by an examination of the series of diagrams on the following page. Only the last two are likely to require explanation. In the course of a flat turn the model will be banked in relation to the fixed datum points, but centrifugal force will throw the liquid outward until it may be more or less in line with the wings. The "picture" shows level flight, while the pointer shows turn; the pilot's conclusions are obvious. In the case of an overbanked turn, gravity will cause the liquid to tilt in relation to the fixed points and increasing the indicated bank of the model.

As far as control movements are concerned, the pilot moves the horizon only by concentrating on the model. If the instrument is indicating as in the fourth diagram, for instance, he would attempt to depress the left wing, the horizon would rise on that side and the rate of turn would be readjusted if necessary. If it was indicating as in the fifth diagram he would endeavour to raise the left wing and the horizon would level itself. So long as the pilot does not confuse himself by attempting to move the

The conspirators between acts: Mr. G. E. Lowdell and Flt. Lt. H. A. Howes snapped a moment before the latter took off to "pose" for the picture at the top of the page. (*Flight* photograph.)



This series of diagrams of the Gyorizon clearly shows the relative positions of the turn indicator needle with its wings and the liquid horizon during different manœuvres.

horizon he cannot go wrong. When flying level on a compass course he would concentrate primarily on the turn indicator—stopping all deviations with the rudder—and then level the model in relation to the horizon. Fore-and-aft indications are given on a separate liquid level of the standard type, but it is likely that, very shortly, a gyro-controlled fore-and-aft level will be available for use in conjunction with the Gyorizon. An example is at present being tried at the C.F.S.

As the turn indicator will work in all attitudes and as the liquid is free to move in all directions within the transparent dial, it is obvious that aerobatics can be carried out on the Gyorizon in conjunction with the A.S.I.

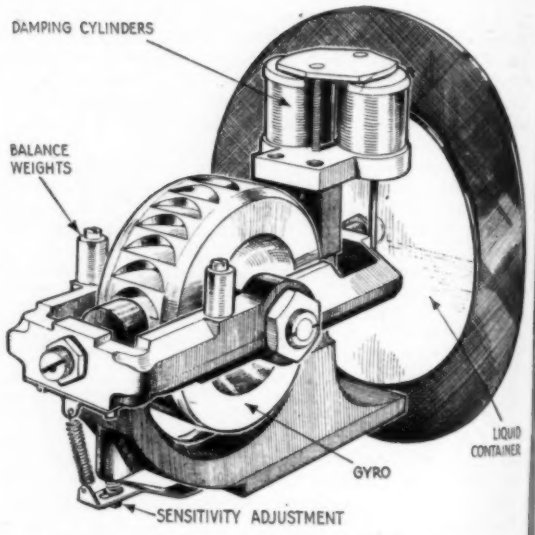
While I was at Desford aerodrome last week I watched a practical demonstration of the fact—for which there is photographic evidence at the head of this article. After only half an hour or so of practice under the hood with Mr. G. E. Lowdell, the chief instructor of the Reid and Sigrist Reserve School, in the front seat, Flt. Lt. H. A. Howes took off by himself in a Tiger Moth, lowered the lid, and proceeded to carry out a series of very presentable slow rolls interspersed with odd half-minutes of inverted flying. *Flight*, incidentally, long ago published the first photograph of a machine being taken off solo with the pilot, Flt. Lt. W. E. P. Johnson, under the hood.

The sensations cannot have been too pleasant when another machine was formating fairly close by—even though this machine was being flown by Mr. Lowdell. Actually, Flt. Lt. Howes suffered a bad ten seconds or so when his engine blew back with such force that he felt convinced that the photographic machine had touched his. Flt. Lt. Howes admitted that his only real difficulty consisted in stopping the roll in a squarely inverted position so that the machine would not fall out at once in one direction or another.

Later in the afternoon Mr. Lowdell slow-rolled and flew inverted, making turns in each direction, while I watched the Gyorizon. The movement of the liquid appeared to be extremely well damped and very little inertia effect was noticeable, while the turn indicator, of course, showed the short turns in the ordinary way.

As one who has done only an hour or two under the hood and perhaps a total of two hours of cloud flying practice with the standard training instrument, I found no real difficulties and flew on it alone for twenty minutes or so. So far as the business of keeping straight and level is concerned, the Gyorizon is the easiest thing imaginable provided that any tendency to turn is stamped out on the rudder at once. Even with the sensitivity control wide open, the turn indicator moves progressively and the liquid level damps itself very effectively, as might be expected.

To the absolute newcomer, the visible horizon effect would be a distinct blessing and yet he would still be taught to "stop the turn first and then adjust the bank." Perhaps because I had been previously taught to make them, I found that flattish turns were still preferable, though it is quite easy to make correct turns on the Gyorizon provided that one is careful to hold the nose up. With any instrument a flat turn still has the advantage of leaving the machine in an almost entirely stable condition. I made my turns with just enough opposite aileron to keep the liquid a little below the datum point on the turning side, and found that a very little skid was enough to prevent the nose from dropping. I did five spins to the right and left and recovered from them all without difficulty, though in three cases,



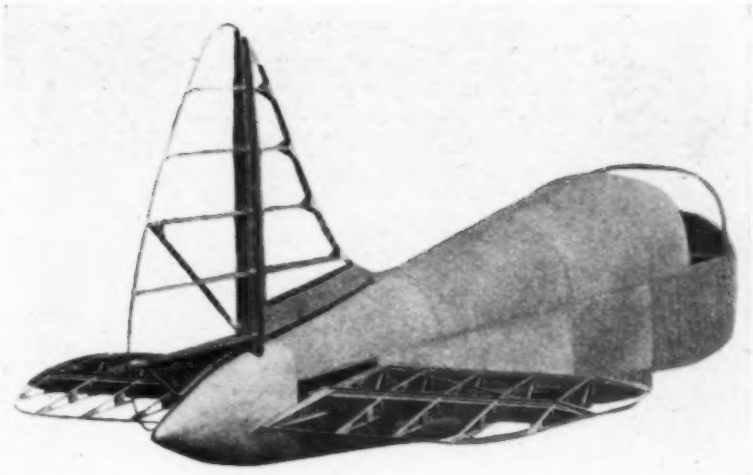
Outside and inside views of the Gyorizon, which, incidentally, weighs only 1 lb. 4 oz.

at least, I was so interested in the work of levelling up the horizon that I allowed the speed to drop again. A little motor would have prevented a second stall.

Though it may always be impossible to incorporate all desirable features in one instrument, the Gyorizon (which is made by Reid and Sigrist, Ltd., of Shannon Corner, Kingston By-Pass, Surrey) certainly marks another step towards that goal. H. A. T.

A BRITISH NEWCOMER

Side-by-side Seating in Light Monoplane to be Produced by Sports Car Makers



The semi-monocoque fuselage and tail unit of the Marendaz monoplane.

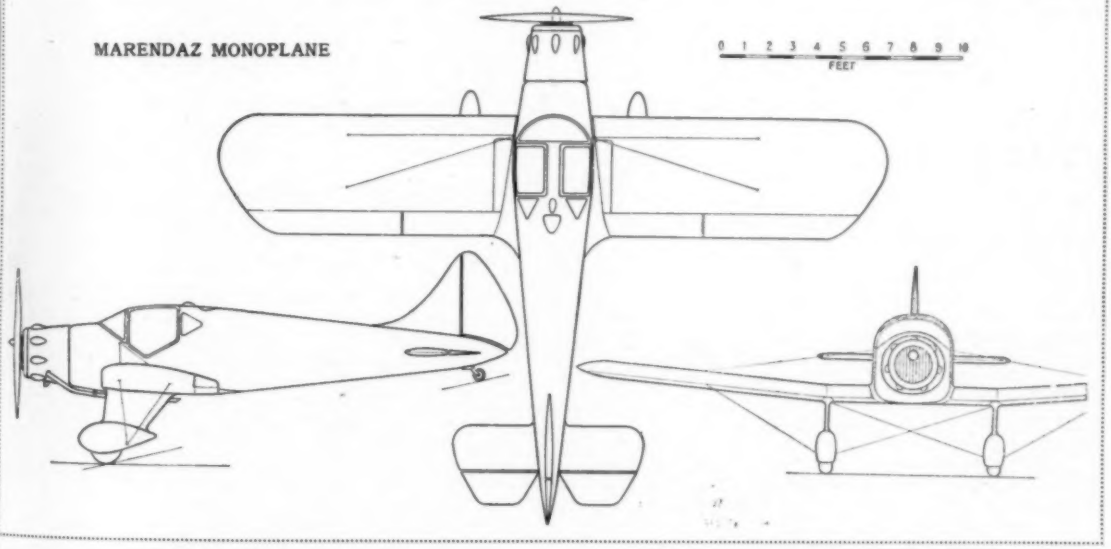
TO the designs of Mr. D. M. K. Marendaz, known to motoring enthusiasts as the designer and manufacturer of Marendaz Special cars, a low-wing two-seater cabin monoplane is being built at Maidenhead. Mr. Marendaz was a war-time pilot and has had experience as a racing driver. Construction of the machine is well in hand.

Complete particulars are not yet available, but the company believes that, due to the machine's simplicity, comprehensive equipment and side-by-side dual control, it will appeal not only to the private owner of moderate means, but also to schools. It is being designed to conform with the Air Ministry's aerobatic requirements.

The fuselage is of semi-monocoque construction, and is wide enough, it is claimed, to provide accommodation equal to that in an Austin Seven car. What engine will be specified as standard has not yet been revealed. Flaps, landing light, differentially operated brakes (patents pending) and undercarriage springing by torsion shaft (patents pending) are features. The price, completely equipped, will be £650.

MARENDAZ MONOPLANE

Span	28ft.
Length	21ft. 5in.
Weight empty	821lb.
Disposable load	550lb.
Luggage allowance	50lb.
Fuel capacity	20 gall.
Wing loading	10.6 lb. sq. ft.
Power loading	15 lb. h.p.
Maximum speed	138 m.p.h.
Cruising speed	120 m.p.h.
Landing speed	45 m.p.h.



A G.A.L. Resignation

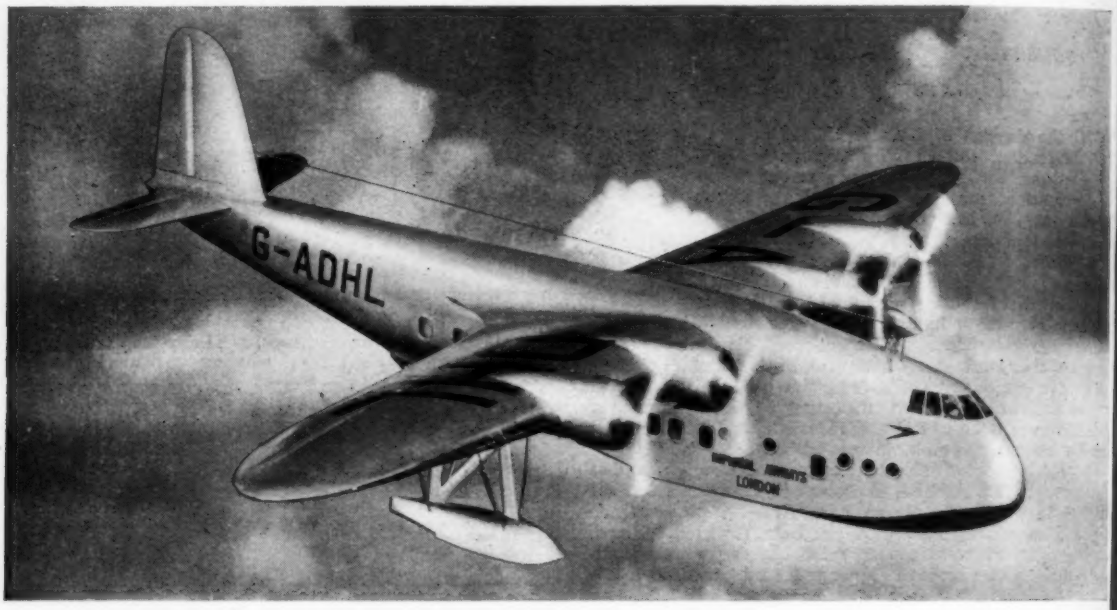
MR. H. J. STIEGER states that he has resigned his position as managing director of General Aircraft Limited. *Flight* readers will doubtless recollect that Mr. Stieger invented the so-called monospar type of wing construction, which consists of a single spar to take the bending loads, a system of spiral bracing opposing any tendency of the wing to twist when the centre of pressure moves off the line of the single spar. It is understood that Mr. Stieger has not yet made definite plans for his future, but one may assume that his technical abilities will not for long remain unused by the British aircraft industry.

Planning—with Something Missing

LAST Friday the School of Planning and Research for National Development gave a preliminary view of its members' work. One would have expected that any scheme of National Planning would of necessity include serious consideration of the future provision of aerodromes and land communications leading to them. The copious and elaborate curriculum of this school touches the subject of air transportation, and shows some sign of air-mindedness; yet it was disappointing to find that the exhibits of various diagrams, the work of the students (or, as they prefer to be called, members) included none relating to the planning of aerodromes.

COMMERCIAL AVIATION

— AIRLINES — AIRPORTS —



ON THE MEDWAY SOON: A new composite picture showing how a flying boat of our new Short Empire class will appear. Notice how, with the reduction in span, the outboard engines are nearing the wing tips. These engines are likely to be 820 h.p. Pegasus Xs and will drive D.H.-Hamilton airscrews.

THE WEEK AT CROYDON

Blind Landings—Croydon "the Only One in Step"? : Night-and-Day Weather : Perambulatory Customs : Distinguished Arrivals : Solemn Thought on Car Parking

LAST week things went much as usual in air transport, though ships were going aground everywhere and trams running down steep slopes into other trams, and so forth. Nobody notices when air transport proves itself infinitely superior to all the more old-fashioned ways of getting about, though the newspapers are quickly enough on our trail when services are interrupted; only the other day there was reference to a "forced" landing when a machine deliberately put in, on instructions from the owners, at an emergency airport.

Last Friday Herr Steinbeck, with a Ju. 52, demonstrated the Lorenz system to a number of interested people [as reported on page 240.—ED.], including, among a Croydon contingent, several senior Imperial pilots and Capt. Morton, chief pilot of British Continental Airways, which company is already fitting machines with this system. The demonstration had to be made at Heston, because the London Terminal Aerodrome, Croydon, is still in the stage when about the best aid to fog landings available is a white chalk line. Most national airports have the Lorenz system, or, if not that system, one for which the same instruments in the aeroplanes can be used. Holland will be about the only country on a different system. The Dutch will doubtless then change over to the Lorenz system and we, in civil aviation, shall set the world another example of international common sense calculated to make Geneva foam at the mouth with jealousy. One day they will hand world affairs to half a dozen air-line chiefs of various nationalities and everything will then doubtless jog along smoothly.

Talking of the Lorenz system, it is an open secret (though why a secret at all I can't think) that two Imperial Airways pilots, Capts. E. Poole and F. C. Allen, who recently flew to Hamburg as passengers by D.L.H., have gone there to study the German blind-approach method under expert tuition, doubtless by means of one of the "flying lecture rooms" reported to be in use there for training purposes. These pilots, it is thought, will operate the first British London-Berlin night mail, which will be inaugurated this coming summer. This seems to be an excellent example of the co-operation between air traffic companies. By the way, I referred to the Vickers Viastra in this connection last week by a slip of the pen when I should have written Velox. Sorry, and all that.

On February 15 the D.H. 86 *Delphinus*, first of her type to be built, still going strong, and now fitted with dual instead of single control, left Croydon for Karachi with Capt. E. R. B. White in command, accompanied by First Officer R. J. Johnstone and First Officer Davys—who is a recent recruit, by the way, from Commercial Air Hire to Imperial Airways. The machine is destined for the Karachi-Singapore sector of the Empire air routes.

Not so long ago I heard one of the oldest Imperial Airways pilots remark that for variety of thoroughly

unpleasant weather, this present winter had every previous one he remembered beaten to a frazzle. He ought to know, for he has, I believe, the longest consistent air line flying record of anyone in this country. It is a curious but by no means meteorologically inexplicable phenomenon that, after horrible day weather, we get marvellous starlit nights during which night-flying pilots have the laugh of their daytime colleagues. Incidentally, equivalent visibility at night is often better than by day, because surface lights show clearly through a light mist. One Imperial pilot the other night, when about twenty miles this side of Beauvais, spotted a glow in the sky alleged by his first officer to be the moon. Said the Captain, "Steer on that, laddie; it's the lights o' London"—and it was so.

Some of these days on which services are maintained only by the use of emergency aerodromes where no Customs facilities exist put a severe strain on the Croydon Customs people. They have to send an official first to Kenley and then Biggin Hill, for example, and possibly again, later in the day, to one of these same places, when and if another machine arrives. The companies owe much to Customs for the cheerful, swift and efficient way in which they handle these matters, which naturally upset their routine at Croydon considerably.

Olley Air Service, Ltd., had a rush ambulance job last Friday when a pneumonia case had to be brought home from the winter sports at Innsbruck. It was successfully accomplished "the Olley way," and a ground ambulance met the Rapide at Croydon.

What I said recently about the need for more mobile refuelling units for next summer was underlined one day last week when a sudden change of weather necessitated filling up with more fuel by both Sabena and K.L.M. morning machines, arrived 8 a.m., for departures respectively at 8.15 and 8.20 a.m. The companies needed different grades of fuel and, to cut a long story short, one service was twenty minutes late simply because one mobile unit cannot serve two machines at once. It does not reflect on the speed and efficiency with which the refuelling crew works, but it definitely proves the need of more of these units.

Notable passengers last week included Maitre Charles Legrand, who arrived by Imperial Airways from Paris with his charming and vivacious wife, also a legal luminary, it is understood. He is briefed on behalf of Roger Vernon in regard to the "Red Max" Kassel case.

There was also M. Lumière from Paris by Air France. He first commercialised films, and it seems to me that Hollywood should make him a present of several million pounds. Miss Jean Batten also flew as a passenger to Paris, where she was welcomed as the guest of the Aero Club of France.

We have just received a notice that parking of cars in the south courtyard of the terminal block is to cease, because not only is this space required for access to Imperial Airways' export department, but also for coke and dustbins. Some of the cars normally parked there might remain under either of these last two clauses.

A. VIATOR.

The Beech "Twin"

ACCORDING to information lately received from the Beech Aircraft Company, their twin-engined monoplane—which, incidentally, will not be in production until July or August this year—will be an all-metal type, except for the fabric-covered control surfaces. Two-way wireless and night-flying gear will be fitted as standard equipment, and the guaranteed cruising speed at 7,000 feet, with two 280-h.p. Jacobs engines, will be 170 m.p.h. A single-engine ceiling of 4,500 feet is also guaranteed.

The machine is being designed with a view to arrangement as an eight-seater, when it will carry 300 lb. of baggage and have a range of 500 miles; as a six-seater with 200 lb. of baggage and 900-mile range; or to carry four people with 150 lb. of baggage for 1,200 miles. The price will be approximately 30,000 dollars.

Passing the Port at Croydon

ACCORDING to Surtees, Mr. Jorrocks, M.F.H., when hunting over what is now the Airport of Croydon, used to breakfast at "The Greyhound," Croydon.

His genial shade seemed to brood over the annual Airport dinner, held there last Friday, when some 300 people were present; for at few functions of this nature could a jollier spirit have been in evidence.

This year we missed a few old friends, among them Major Richard and Mrs. Richard, as well as Capt. Chattaway.

Air Commodore E. D. M. Robertson, C.B., D.F.C., took the chair, and in a brief, incisive, but genial speech, had a good-humoured dig at certain parties, who responded with unrepentant grins. The Airport had the opportunity of welcoming Mrs. Robertson and the cheers for the chairman and his wife were indeed hearty.

One noticed that British Continental Airways, Ltd., newcomers since last year, occupied a whole table to themselves, and paraded some thirty strong, with sweethearts, wives and their chief pilot, who brought his beard.

Besides the chairman, other speakers were Mr. Brian Allen, whose toast was "The Ladies," responded to very ably by Mrs. Horsey, wife of one of Imperial Airways senior pilots. She seemed to think that, all very well as they might be in their way, menfolk were not all that they supposed themselves to be and expected their wives to believe they were. Mr. Gerald Taylor welcomed "The Visitors," and Flt. Lt. Miller responded.

Considerable credit is due to Mr. Charlie Allen, Mr. Thomson, Mr. Crook and Mr. "Joe" Chamberlain for organising the affair.

Kinner's Biggest

THE American Kinner concern, which has been concentrating on the production of comparitively small aircraft and appropriate engines, is entering the "feeder line" market with a new twin-engined monoplane known as the Invader. The power units will be the new 370-h.p. Kinner C-7 seven-cylinder supercharged radials, and the estimated maximum speed will be 210 m.p.h. at 5,000 feet. In its standard form it will be a six-seater, but more passengers can be carried with a correspondingly reduced range.

Twelve Days from Shanghai

THE first through mail from Shanghai and Hong Kong was brought in at Croydon on Monday by the mid-day Air France machine, having covered the 10,000 miles from Shanghai in twelve days, the fastest time ever achieved for mail.

This new service was an inaugural one and will be speeded up in the course of future operation. It already saves nearly a week on the time taken by the Trans-Siberian Railway route—hitherto the fastest mode of communication. An agreement, negotiated largely by France's air attaché at Canton, is responsible for the establishment of this valuable new link. By its terms an all-Chinese line operated by the Chinese Ministry for Communications is authorised to establish a regular mail service in both directions from Canton to Hanoi, stopping at Fort Bayard and working in co-operation with Air France. The time-tables of the Chinese company are at all times to be subordinated to those of Air France. The line is, according to the agreement to be operated exclusively by Chinese personnel, but during the first six months, in order to assure a regular and efficient service, pilots are being borrowed from the China National Aviation Corporation. The agreement is for seven years with power of renewal at the end of the period, but the French Air Ministry reserves the right to terminate it should any agreement between Chinese aviation and another foreign concern militate against the interests of the service. The machines, too, are to be of French manufacture where Chinese material cannot be utilised.

The far Eastern service of Air France, between Marseilles and France's colonial possessions in Indo-China, is already one of the fastest lay-distance air lines, the 9,000 miles to Saigon and Hanoi being covered in ten days on a weekly schedule. Recently, the new Potez 62's, fitted with eight sleeping berths (or fourteen seats) and cruising at 185 m.p.h. have been put on this service. According to the summer plans, the distance will be covered in seven days.

Commercial Aviation

BLIND APPROACHES in ENGLAND

The Lorenz Equipment Demonstrated at Heston Airport

SINCE the Lorenz blind landing system was first described and illustrated in *Flight* of February 14 last year, by a member of the staff who made a special visit to Berlin for this purpose, a number of references have been made to it. In the special airports number (January 30, 1936), for instance, the system was again described, and the Heston approach line, as well as the position of the main and second marker beacons, were illustrated on p. 120. Last week, in an article describing the navigational methods in use on the Swissair London-Zurich route, the system was described from the pilot's angle after an experience with it in actual service.

The more earnest students of modern air transport developments should, by now—even if allowance is made for the delayed action of the brain—be fairly conversant with the general principles.

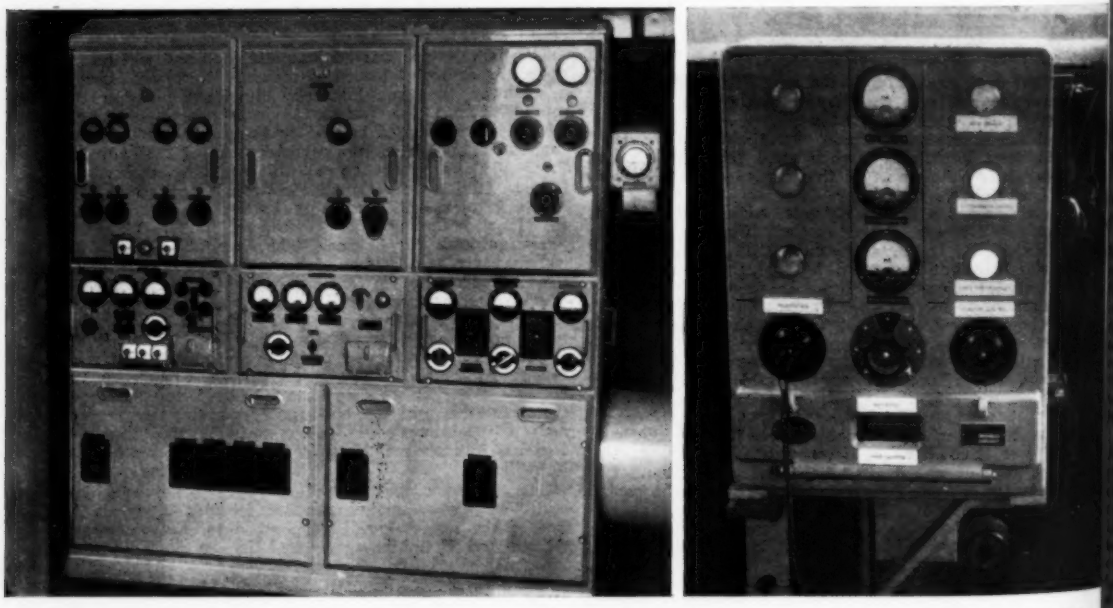
Briefly, however, deformed radio beams, with a wavelength of 9 metres, are used to provide a flight path towards the aerodrome, visual and aural signals being given by suitable instruments to provide the pilot with an indication of his lateral and vertical position in these overlapping beams. Of the two marker beacons, transmitting vertically (on 7-9 metres) and lying in the approach path, the first tells the pilot when to throttle back and when he must be ready to watch the vertical indication, and the second tells him that it is time to prepare for the actual touch-down. A barometrically adjusted sensitive altimeter is used in conjunction with the system, so that the pilot has a further check on the vertical indications.

Standard Telephones and Cables have the manufacturing rights in this country, while Smith's Aircraft Instruments now handle all the former company's "flying" products. Indeed, a D.H. Dragon is, as already mentioned in *Flight*, being fitted up as a flying showroom or laboratory.

The most interesting feature of the Lorenz equipment in its now standard form is the fact that it is virtually meddle-proof. No part of the main beacon transmitter can be reached without the use of a special key which is itself, in fact, a master switch. Any failure is signalled in the airport control office, where a complete repeater is installed, and where the equipment can be switched on and off. The repeater tells the control officer whether the main beacon is transmitting at the correct power, whether the keying system (for giving the directional signals) is functioning, and whether the two marker beacons are in order. The first of these is situated in Osterley Park, and is fed from the mains, while the second lies just beyond the western boundary and is fed from Heston's own boundary lighting circuit—a convenient arrangement.

Behind the main beacon at Heston: The Ju.52 is making a demonstration approach. (*Flight* photograph.)

On Friday afternoon a D.L.H. Ju.52 was brought over for the demonstrations. At present, only one machine in this country—Standard's own Puss Moth, which is also equipped with the radio compass described in *Flight* of December 19, 1935—is fitted with the complementary receiving equipment, though four of British Continental Airways' machines, at least, are to be so fitted in the near future.



The compact Lorenz main beacon transmitting equipment (left) and the repeater in the control tower. (*Flight* photograph.)

To the Goldfields

THE new Australian company, Airlines (W.A.), Ltd., about which details were given in *Flight* some time ago, has now started operations with a Monospar S.T.25. A single-engined machine is held in reserve. The route, which is a circular one embracing Perth and the goldfields, is covered on Thursday and Friday of each week, a night being spent at Wiluna. The manager and chief pilot is Capt. C. W. Snook, with F/O F. Townsend as assistant pilot.

The L.Z.129

THE new Zeppelin L.Z.129 is expected to leave Frankfurt on May 6 on her maiden voyage to Lakehurst, New Jersey, carrying passengers as well as mails and freight. Other flights will be made across the North Atlantic during the year. Presumably, the new airship base at Frankfurt-on-Main will be opened at the same time.

It is possible that a trial flight to Java will also be made during the year. The Netherlands Steamship Company is one of several which are interested in promoting a regular airship service between Holland and the Dutch East Indies.

The *Graf Zeppelin* will leave for her first South American trip on March 30. Twenty-two trips are scheduled for this year—some being made by the L.Z.129.

An American Traffic Record

IN the annual report of traffic returns which has recently been published by United Air Lines, it is reported that, on its coast-to-coast and other routes, the company flew 87,108,711 passenger-miles last year, a figure which, it is stated, has never been equalled by any other air line in the world. The report also shows that the number of passengers carried by this company increased by 21 per cent.—147,139 were carried in 1934 and 177,457 in 1935. A substantial increase was also shown in the amount of mail carried. The traffic controlled by United, in fact, represented 30 per cent. of passenger-miles in the U.S.A., 40 per cent. of all air mail, and more than half of the country's air express. The fleet of fifty machines were flown 14,503,197 miles in scheduled operation during 1935, or approximately a million miles more than in the previous year.

The larger portion of the company's increased traffic has been on its New York-Chicago-Pacific Coast route, with a satisfactory gain also on the Seattle-San Diego route. In the near future United Air Lines will have completed the sound-proofing and redecoration of its fleet.

Irish Developments in 1935

FOR the first time since the Irish Free State was first constituted, just fourteen years ago, the Government of that country is showing a live interest in civil flying.

Until November, 1935, the successive Governments of the Free State had adopted a policy of *laissez-faire* with regard to flying, the only previous gesture made being the granting of permission to the Irish Aero Club in 1928 to use the military aerodrome at Baldonnel, Co. Dublin, and the subsequent voting of a grant-in-aid of £1,000 to this club.

Last year, however, the Department of Industry and Commerce and Sir Alan Cobham discussed the establishment of an air service between Great Britain and the Irish Free State. These negotiations were dropped during the latter end of the summer, but were later reopened by Olley Air Service. In November it was announced to the Dail by the Minister for Industry and Commerce, Mr. Sean Lemass, that an air service would be established between Dublin and Bristol, and Dublin and Liverpool early in 1936. The service, he said, would be operated jointly by an Irish board and Olley Air Service. A vote of £3,500 for a wireless installation at Baldonnel aerodrome was passed and the contract for this was awarded to the Marconi Company.

The Irish concern will, at a later date, become a subsidiary of a national air transport company, which is to finance aircraft operating companies. Legislation to put this into effect is now being drafted. An order was also issued by the Free State Government prohibiting the establishment of air routes between the Irish Free State and Great Britain (or other countries) except with the permission of the Minister for Industry and Commerce.

Earlier in November Mr. J. P. Walshe, secretary of the Department of External Affairs, and Mr. Sean Leydon, secretary of the Department of Industry and Commerce, went to Ottawa for a conference with representatives of Great Britain, Canada, and Newfoundland, regarding the establishment of the Trans-atlantic air service. At the present time the general indications are that Foynes, near Limerick, on the River Shannon, will become the eastern terminal or refuelling base for such a service.

Northern Ireland made considerable progress during the summer of 1935 when three services were operating between Great Britain and Belfast. These used Ards Airport, Co. Down, which was then operated by Airwork, Ltd., for Lord Londonderry, who has now taken over the complete control.

SOUTH AFRICAN PROSPECTS

Unprecedented Activity Among the Clubs : Shortage of Instructors and Air-line Pilots

IT seems to be the general impression (writes a correspondent) that the South African Government is the only potential purchaser of aeroplanes in South Africa. Aeroplane manufacturers and those industries which cater for aeroplane accessories and aerodromes also seem to be somewhat dubious about their opportunities in the South African market.

To some extent this inactive attitude has been encouraged by the fact that the South African Government has made considerable purchases from Germany. The situation, however, is not now so black. As reported some time ago in *Flight*, Airspeed have supplied several Envoys to the Union Government, and these should be operating on the South African air routes this summer. Another firm, De Havillands, have advised their Johannesburg general manager to take space at the Empire Exhibition, and Imperial Airways are taking the whole of their exhibit, until recently on view in the Science Museum at South Kensington, to South Africa.

It is a mistake, however, to regard the Government of South Africa as the only purchaser, or potential purchaser, of aeroplanes and accessories. During the period 1927-34 ten flying clubs were established in the Union, without State assistance, at Johannesburg, Germiston, Pretoria, Bulawayo, Witbank, Durban, East London, Port Elizabeth, Cape Town and Bloemfontein. For some time, owing to financial stringency, most of these clubs were compelled to cease flying. During 1934, however, the clubs at Johannesburg and Germiston, and a flying school at Cape Town, flew a total of 5,276 hours, carried 7,141 passengers and trained fifty-three pupils for their "A" licences. The number of Civil Aviation Licences and Certificates issued to the Union up to the end of 1934 was as follows: 269 "A" pilots, 100 "B" pilots, 79 ground engineers, 71 aerodromes and 134 aircraft.

At the present time South Africa's fortunate financial condition has made it possible for her to show practical interest in air transport. That this is so is illustrated by the fact that Durban's aviation enthusiasm has gone ahead so rapidly that it has beaten the sponsors of the flying school. For weeks past the authorities of the school have been trying to obtain the services of additional instructors, but in spite of their having scoured the Union and Rhodesia they have failed. More than sixty pupils are enrolled in the Durban school, and the registrations are increasing weekly. The Government schemes for making aviation more popular have had the effect of causing what is tantamount to a rush on the aviation schools by the youth of the country.

The shortage of pilots is being felt increasingly, and it is considered likely that even South African Airways (the English service operated by the Union) will feel the shortage keenly when the new British passenger machines arrive in the country for service on the South African Airways' routes.

All this means that the prospects for British aircraft manufacturers and suppliers of accessories and the makers of aerodromes are most promising. Particularly aerodrome furnishers should find the market full of promise, since South Africa's vast area calls for a considerable increase in the number of aerodromes.

THE INDUSTRY

Publications of Interest to Works Engineers and Others : Institute of Metals Discussion : Short Bros. Celebrate

Anti-corrosive Undercoats

A DESCRIPTIVE pamphlet containing an application schedule for Cerrex anti-corrosive undercoats and temporary protectives (see *Flight* of February 20) has just been issued by Cellon, Ltd., of Kingston-on-Thames.

Heat Regulation

DETAILS of Cambridge automatic regulators for furnace and similar duties are given in a catalogue issued by the Cambridge Instruments Co., Ltd., 45, Grosvenor Place, London, S.W.1.

Shaping Sheet

BENDING, folding and rounding machinery for sheet and strip metal is described in a catalogue—which should be of considerable interest to the aircraft industry—issued by Hunton, Ltd., Phœnix Works, 114-116, Euston Road, London, N.W.1.

About Insurance

A VERY clear exposition of the not-too-well-understood subject of aviation insurance, including the new problems raised by third-party cover, is given in a booklet issued by the Aviation and General Insurance Co., Ltd., 33, Lime Street, London, E.C.3.

Tool Steels

TWO E.S.C. publications—a handbook and a leaflet respectively—of interest to works managers have recently been issued under the titles of "Tool Steel" and "Files and Rasps." They are obtainable from the English Steel Corporation, Ltd., Vickers Works, Sheffield.

Electric Hoists

PARTICULARS of Demag electric hoists, which are made in a large number of different types, many of which would appear to have applications in the aircraft industry, are given in a catalogue issued by the makers, the Aabacas Engineering Co., Ltd., of 10, Canning Place, Liverpool, 1.

Home from the Antipodes

MR. A. C. FALL, engineer to British Timken, Ltd., Birmingham, arrived back in England last week after a lengthy tour of Australasia. He left England in December, 1934, to superintend the first application of anti-friction bearings to the Queensland Government Railways, and during the past twelve months he has lectured to many engineering societies in Australia and New Zealand.

Alloy Specialists' Dividend

IT is announced that the directors of James Booth and Co. (1915), Ltd., of Birmingham, the well-known alloy specialists, have decided to recommend a dividend of 15 per cent., less tax, on the ordinary shares for the year ended December 31. The annual meeting, to be held on March 12, will be followed by an extraordinary meeting to increase present authorised capital to enable the directors to offer to ordinary shareholders, at a premium of £1 per share, one new ordinary share for each five ordinary shares held by them.

Pneumatic Tools

THE range of pneumatic tools for aircraft duties which Broom and Wade, Ltd., of High Wycombe, have been developing during the past year has now been considerably augmented, and full data regarding ten different types of tools, each made in various sizes, is given in a catalogue which they have recently issued.

These tools include hammers of various patterns for riveting, caulking, chipping, etc.; multi-vane instruments for drilling, nut running and screw setting; multi-vane grinders; and polishers and sanders for work on large surfaces.

Small dimensions and low weight are a feature of the majority of these tools.

Problems of Metallic Wear

THE Institute of Metals is arranging a special meeting to discuss the subject of "Metallic Wear." It will take place in London on March 10, in connection with the Institute's annual general meeting. The discussion will be opened by Dr. H. W. Brownsdon (member of the council) with a paper reviewing some of the major factors which the subject involves. Members of other institutions—including the Institution of Mechanical Engineers, the Institution of Naval Architects, the Institution of Automobile Engineers, the Iron and Steel Institute, and the Royal Aeronautical Society—have been invited to attend the meeting and to take part in the discussion. Cards of invitation may be obtained from Mr. G. Shaw Scott, M.Sc., Secretary, The Institute of Metals, 36, Victoria Street, London, S.W.1.

Short Staff Celebrates

SOME 150 members of the staff of Short Bros., Ltd., recently travelled to London for their annual dinner which followed a visit to a theatre. In proposing "The Firm," Mr. A. Gouge, director and general manager, thanked those present for their loyal support during the year and paid a warm tribute to the managing director, Mr. Oswald Short, who, in his reply, said that it was pleasing to note that, with the rapid progress in design now taking place, the name of Short Bros. was still in the forefront and all new designs from their works were watched with the keenest interest throughout the world.

Among those present were also Mr. F. S. Short; Mr. J. Lankester Parker, chief test pilot; Capt. A. Maver, London office representative; Mr. F. Drury, cashier; Mr. C. Lipscombe, assistant chief designer; Mr. W. Browning, chief technical assistant; Mr. W. C. Jackson, chief draughtsman; Mr. J. A. C. Manson, late resident technical officer; Mr. P. H. Harrower, chief A.I.D. inspector; Mr. P. H. Cozens, machine-shop manager; Mr. Lower, float department superintendent; Mr. Clarke, aerodrome superintendent; Mr. Parks, section leader on Empire boats; and Mr. Parker, section leader on military boats.

AERONAUTICAL PATENT SPECIFICATIONS

(The numbers in brackets are those under which the Specifications will be printed and abridged, etc.,)

Published February 27, 1936.

21782. SMITH, H. A. (ZEGERS, A.): Propeller wheels (442,009).
22019. KAY GYROPLANES, LTD., KAY, D., AND DYER, J. W.: Aircraft (442,012).
22020. KAY GYROPLANES, LTD., KAY, D., AND DYER, J. W.: Aircraft (442,014).
22021. KAY GYROPLANES, LTD., KAY, D., AND DYER, J. W.: Aircraft (442,016).
22022. KAY GYROPLANES, LTD., KAY, D., AND DYER, J. W.: Aircraft (442,018).
22226. TENNANT, W. J. (SOC. DES APPAREILS D'AVIATION M. GIANOLI): Servo motors for use on vehicles (442,027).
22352. KRUMMER, A.: Collapsible and extensible linkages (442,091).
28400. DUNLOP RUBBER CO., LTD., GOODYEAR, E. F., WRIGHT, J., AND TREVASKIS, H.: Aircraft controls (441,946).

NEW COMPANIES

In the notes below, for reasons of space, the "objects" of new companies are usually somewhat abbreviated.

AIR PILOTS TRAINING LTD.—Private company, registered February 14. Capital £100 in £1 shares. Objects: To carry on the business of instructors in aviation, etc. First directors to be appointed by the subscribers. Registered office: 380, Gresham House, Old Broad St., London, E.C.

LANG PROPELLORS, LTD.—Private company, registered February 14. Capital, £100 in £1 shares. Objects: To acquire patents, inventions, and secret processes relating to aeroplane propellers; to carry on the business of manufacturers of aircraft and parts, etc. The first directors are not named. Solicitors: Denton, Hall & Burgin, 3, Gray's Inn Place, London, W.C.1.

INCREASES OF CAPITAL

AIRCO LTD. (Aircraft consultants, designers, etc., 3, St. James's Square, London, S.W.1).—The nominal capital has been increased by the addition of £1,000 in £1 ordinary shares beyond the registered capital of £1,000.

PUBLICATIONS, ETC., RECEIVED

How to Build Flying Boat Hulls and Seaplane Floats, by J. Streeter. Aeronautical Engineering Series, Price 6s., Sir Isaac Pitman and Sons, Parker Street, Kingsway, London, W.C.2.

Flying and Soldiering, by R. R. Money. Price 8s. 6d., Ivor Nicholson and Watson, Ltd., 7, Paternoster Row, London E.C.4.